Cairo University

THERMOELECTRIC BEHAVIOR OF NON CONDUCTING / CONDUCTING POLYMERIC MATERIALS

By

Hussein Osama Mohamed Badr

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
METALLURGICAL ENGINEERING

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Title of Thesis:

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Key Words:
Thermoelectricity; Seebeck Coefficient; Insulating and Conducting Polymers; Polyaniline; Carbon nanotubes.

Summary:
As on the increasing energy crisis, large amount of heat are reported to be lost at low temperatures (up to 250 ^{o}C), that can reach more than 70 % of the total waste heat, the market is motivated for seeking of new materials for low temperature thermoelectric applications (LTTA). Organic materials, with their well-known properties of light weight, abundancy, versatility, low cast, ease of synthesis and processing, low thermal conductivity, in addition to eco-friendly and sustainability, show large findings in LTTP with their additional superior adjustment to be semiconducting / conducting moderate temperature stable materials (up to 300 ^{o}C). However all of these advantages, lower values of figure of merit were recorded for polymers and polymer composite that motivates for deep study of thermoelectric properties of polymers for the aim of understanding and developing new methodologies for organic thermoelectric materials.

Disclaimer

I hereby declare that this thesis is my original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Dtae:

Signature:

Dedication

I dedicate this thesis to my parents. I dedicate this thesis to my mother (Mrs Amira Elsayad) that Dedicated all her life as an investment in growing her sons to be two successful and remarkable persons and hope this thesis to one step toward her dream. I deeply dedicated this thesis to my father (Colonel / Osama Badr) that passed away in 2003. He wishes to see me with the primary school certificate before going to the afterlife; sure he is proud of me now obtaining my primary graduate school step (Masters degree) to be a scientist.

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Contents

List of figures

List of Tables

Nomenclature

Abbreviation	Name
GDP	gross domestic product
EIA	energy information administration
PV	Photovoltaic
TE	Thermoelectricity
ZT	thermoelectric figure of merit
S	Seebeck Coefficient
σ	Electricacal Conductivity
K	Thermal Conductivity
PF	Power Factor
η	Power Conversion Efficiency
PGEC	phonon glass electron-crystal
HH	Half Heusler
VEC	the valence electron count
CNTs	Carbon nanotubes
MWNTs	Multi wall Carbon nanotubes
SWNTs	Single wall Carbon nanotubes
dppp	bidentate phosphine ligands, 1, 3-bis(diphenylphosphino) propane
CPs	conducting polymers
P3T	polymethylthiophenes
PEDOT	poly (3,4-ethylenedioxythiophene)
PANI	polyanilines
HCl	hydrochloric acid
CH_3SO_3H	methansulphonic acid
CSA	camphor sulfonic acid
PSB	poly-Schiff bases
PS	Polystyrene
PVAc	Poly (vinyl acetate)
DOC	sodium deoxycholate
TCPP	meso-tetra (4-carboxyphenyl) porphine