

SYNTHESIS OF BARIUM TITANATE
NANOCUBES BY HYDROTHERMAL
METHOD

WONG KIN FUNG

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UNIVERSITI MALAYSIA TERENGGANU
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Kang Fung.

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SYNTHESIS OF BARIUM TITANATE NANOCUBES BY HYDROTHERMAL
METHOD

By
Wong Kin Fung

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THESIS CONFIRMATION AND APPROVAL

This is acknowledged and confirmed that thesis entitled: *Synthesis Barium Titanate Nanocubes By Hydrothermal Method* by Wong Kin Fung Matric No.: S39251 have been checked and all the suggested corrections have been done. The thesis is submitted to School of Ocean Engineering, Universiti Malaysia Terengganu in partial fulfillment of the requirements for the award of the degree of Bachelor of Applied Science (Electronics and Instrumentation Physics).

Authorized by:



Date:

10/6/18

.....
Main Supervisor

Name:

Dr. Lee Oon Jew

Official Stamp:

DR. LEE OON JEW

Lecturer

School of Fundamental Science

Universiti Malaysia Terengganu

21030 Kuala Terengganu

Terengganu, Malaysia

Date:

.....
Co-Supervisor (If any)

Name:

Official Stamp:



Date:

11/6/18

.....
Programme PITA Coordinator

Bachelor of Applied Science (Electronics
and Instrumentation Physics)

Name:

Prof. Madya Dr Mohammad Bin Ismail

Official Stamp:

DR. MOHAMMAD BIN ISMAIL
Lecturer
School of Ocean Engineering
Universiti Malaysia Terengganu

DECLARATION

I hereby declare that this thesis is the result of my own research except as cited in the references.

Signature : 

Name : Wong Kin Fung

Matric No. : S 39251

Date : 11/6/2018.

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SYNTHESIS OF BARIUM TITANATE NANOCUBES USING HYDROTHERMAL METHOD

ABSTRACT

In this work, BaTiO₃ has been synthesized via hydrothermal method using Titanium (IV) bis (ammonium lactate) dihydroxide solution and Barium dihydroxide as the Ti and Ba precursors, respectively as well as 3M of NaOH. The synthesis process was undertaken in an oven at the temperature range of 230°C - 250°C since low temperature was needed compared with other wet-chemical methods. Oleic acid and tert-butylamine were used as the surfactants to control the morphology and the size of the BaTiO₃ particles by tuning the concentration of the formers. The synthesized powders were calcined and then characterized by X-ray Diffraction (XRD), Fourier Transform Infrared Spectrometer (FTIR) and Scanning Electron Microscopy (SEM). The powders were later pressed into pellets and sintered at 1300°C. The sintered pellets were further characterized using Electrochemical Impedance Spectroscopy (EIS). The powder calcined at 900°C showed the formation of single phase BaTiO₃ nanocubes. Through the EIS characterisation, highest dielectric constant was obtained at 1kHz for the molar ratio of 1:18:18, which is 579.15. It is evident that hydrothermal synthesis method is the cost effective, temperature controlled and alternative way to synthesize single-crystalline BaTiO₃ in the nano-sized and cubic morphology.

SINTESIS NANOKIUB TITANATE BARIUM MENGGUNAKAN KAEDAH HIDROTERMA

ABSTRAK

Dalam kajian ini, BaTiO₃ telah disintesis melalui kaedah hidroterma menggunakan penyelesaian dihydroxide Titanium (amidium laktat) dan Barium dihydroxide sebagai Ti dan Ba prekursor, masing-masing serta 3M NaOH. Proses sythesis dilakukan di dalam ketuhar pada suhu 230°C - 250°C kerana suhu rendah diperlukan berbanding kaedah basah kimia lain. Asid oleik dan tert-butylamine digunakan sebagai surfaktan untuk mengawal morfologi dan saiz partikel BaTiO₃ dengan menala kepekatan para pembentuk. Serbuk yang disintesis dikalsin dan dicirikan oleh Difraksi X-ray (XRD), Fourier Transform Spektrometer Inframerah (FTIR) dan Mikroskopi Pengimbasan Elektron (SEM). Serbuk kemudiannya ditekan menjadi pelet dan disinter pada 1300°C. Pelet yang disinter telah dikenalpasti dengan menggunakan Spektroskopi Impedansi Elektrokimia (EIS). Serbuk kalsium pada 900°C menunjukkan pembentukan nanocube BaTiO₃ fasa tunggal. Melalui pencirian EIS, pemalar dielektrik tertinggi diperoleh pada 1kHz untuk nisbah molar 1:18:18, iaitu 579.15. Adalah jelas bahawa kaedah sintesis hidroterma adalah kos efektif, suhu terkawal dan cara alternatif untuk mensintesis BaTiO₃ tunggal-kristal dalam morfologi berukuran nano dan padu.