SYNTHESIS, MECHANICAL PROPERTIES AND MICROSTRUCTURE OF DUAL MATRIX (DM) ALUMINUM - BORON NITRIDE NANOTUBE (Al – BNNT) COMPOSITES.

By
Kirolos Mikhail Henry Bastwros

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
Mechanical Design and Production Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Under the Supervision of

Prof. Dr. Abdalla S. Wifi
....
Professor
Mechanical Design and Production Engineering
Faculty of Engineering, Cairo University

Prof. Dr. Amal M. K. Esawi
....
Professor
Mechanical Engineering
Faculty of Engineering
American University In Cairo

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Approved by
Examining Committee

Prof. Dr. Abdalla S. Wifi Cairo University	Thesis main advisor
Prof. Dr. Amal M. K. Esawi The American University in Cairo	Advisor
Prof. Dr. Ragaie Mohammed Rashad Hassan Cairo University	Internal examiner
Prof. Dr. Tamer Samir Mahmoud Abdel-Magid Vice Dean of Education and Student Affairs, Faculty of Engineering at Shoubra, Benha University	External examiner

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2020

Engineer's Name:	Kirolos Mikhail Henry Bastwros
Date of Birth:	21 / 06 / 1989
Nationality:	Egyptian
E-mail:	k.bastawros @aucegypt.edu
Phone:	01288226781
Address:	45 Kasr El Ainy Street
Registration Date:	1 / 3 / 2014
Awarding Date:	…./…./ 2020
Degree:	Master of Science
Department:	Mechanical Design and Production Engineering

Supervisors:

Prof. Dr. Abdalla S. Wifi
Prof. Dr. Amal M. K. Esawi

Examiners:

Prof. Dr. Tamer Samir Mahmoud Abdel-Magid (External examiner)
Vice Dean of Education and Student Affairs,
Faculty of Engineering at Shoubra, Benha University

Prof. Dr. Ragaie Mohammed Rashad Hassan (Internal examiner)

Prof. Dr. Abdalla S. Wifi (Thesis main advisor)

Prof. Dr. Amal M. K. Esawi (Advisor)

Title of Thesis:

SYNTHESIS, MECHANICAL PROPERTIES AND MICROSTRUCTURE OF DUAL MATRIX (DM) ALUMINUM - BORON NITRIDE NANOTUBE (Al – BNNT) COMPOSITES.

Key Words:
Boron nitride nanotube; metal matrix composites; Dual matrix Aluminum composites; Combined Tube cold rolling.

Summary:

One type of BNNT-aluminum composite is investigated in the present study, namely a dual matrix composite, where pure unmilled Al powder is mixed with an equal weight of a single matrix aluminum-2wt% BNNT composite powder. The present study has shown that the low energy mixing technique is found to be inefficient method for homogeneously dispersing BNNT (2wt%) into aluminum matrix. However, it is found to be efficient when used in preparing of Dual matrix composites and bi-modal structure aluminium. The use of combined uniaxial compaction followed by single pass tube cold rolling, and sintering, the DM composites effective 1wt% of BNNT, leads to an increase in mechanical properties.

Disclaimer

I hereby declare that this thesis is my own 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: Kirolos Mikhail Henry Bastwros Date: …/…./……

Signature:

Dedication

To my family,…

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ρ_{Al}	Density of pure Al.
ρ_{Ref}	Density of the reinforcement as reported from the supplier.
ρ_{exp}	Experimentally measured density of the sample.
ρ_{l}	Auxiliary liquid density.
ρ_{th}	Theoretical density of the composite.
Dens %	Densification percent of the composite
Vf_{Al}	Volume fraction of the Al in the composite.
Vf_{Ref}	Volume fraction of the reinforcement in the composite.

Nomenclature

MMC	Metal matrix composite
PMC	Polymeric matrix composite
CMC	Ceramic matrix composite
BNNT	Boron nitride nanotubes
Al-BNNT	Boron nitride nanotubes-reinforced aluminum matrix
CNT	Carbon nanotubes
Al-CNT	Carbon nanotubes-reinforced aluminum matrix
SM	Single matrix
DM	Dual matrix
MM	Mechanical milling
MA	Mechanical alloying
HEBM	High energy ball milling
LEM	Low energy mixing
TEM	Transmission electron microscope
SEM	Scanning electron microscope
FESEM	Field emission scanning electron microscope
PCA	Process controlling agent
PM	Powder metallurgy
HPT	High pressure torsion
SPS	Spark plasma sintering
BPR	Ball to powder ratio