GROWTH OF CARBON NANOSTRUCTURE ARRAYS ON NICKEL ELECTROPLATED COPPER SUBSTRATE

ROSZAINI BINTI MD SALLEH

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GROWTH OF CARBON NANOSTRUCTURE ARRAYS ON NICKEL ELECTROPLATED COPPER SUBSTRATE

by

ROSZAINI BINTI MD SALLEH

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LIST OF ABBREVIATIONS

AFM	Atomic force microscopy
CCVD	Catalytic chemical vapour deposition
CNFs	Carbon nanofibers
CNS	Carbon nanostructures
CNTs	Carbon nanotubes
CVD	Chemical vapour deposition
DC	Direct current
DTG	Differential thermogravimetric
EDX	Energy Dispersive X-ray
G-CNTs	Graphitized carbon nanotubes
MWCNTs	Multiwalled carbon nanotubes
PVD	Physical vapour deposition
TIM	Thermal interface materials
SEM	Scanning electron microscopy
SWCNTs	Single walled carbon nanotubes
TEM	Transmission electron microscopy
TG	Thermogravimetric
TGA	Thermogravimetric analysis
XRF	X-ray fluorescence

LIST OF SYMBOLS

Al_2O_3	Aluminium oxide
Ar	Argon
Co	Cobalt
℃	degree celcius
C_2H_2	Acetylene
Cu	Copper
Fe	Iron
g/l	gram /litre
HV	kg_f/mm^2
H_2SO_4	Sulphuric acic
H_2	Hydrogen
mA/cm^2	miliampere/centimetre^2
min	minutes
Ni	Nickel
nm	Nanometre
N_2	Nitrogen
Pd	Palladium
sccm	Standard cubic centimetre per minute
Si	Silicon
SiO_2	Silicon oxide
wt %	Weight percent

PERTUMBUHAN TATASUSUNAN KARBON NANOSTRUKTUR DI ATAS SUBSTRAT KUPRUM TERELEKTROSADUR NIKEL

ABSTRAK

Sejak penemuan karbon nanotiub (CNTs) pada tahun 1991 oleh Iijima, karbon nanostruktur (CNS) yang terdiri daripada karbon nanotiub(CNTs) dan karbon nanofiber (CNFs), telah mendapat perhatian dalam kalangan pengkaji berikutan ciri-ciri luar biasa bahan ini. Banyak aktiviti penyelidikan dan penemuan baru berkaitan dengan potensi CNS telah diterokai dari semasa ke semasa. Salah satu potensi CNS ialah boleh digunakan sebagai bahan antara dua muka haba (TIM) dan diaplikasi di dalam bahan elektronik berikutan CNS merupakan pengalir haba yang baik. Jadi, kajian penyelidikan ini memberi tumpuan kepada sintesis CNS yang bekualiti dan berketumpatan tinggi di atas platform pada suhu pertumbuhan yang rendah ke arah merealisasikan potensi CNS sebagai TIM pada masa akan datang. Bahagian pertama dalam kajian penyelidikan ini ialah penyediaan bahan penyebaran haba menggunakan kaedah elektropenyaduran sebelum pertumbuhan CNS. Kaedah elektropenyaduran digunakan untuk menyalut pemangkin logam aktif, nikel ke atas kuprum yang bertindak sebagai substrat kerana mengandungi nilai pengalir haba yang tinggi manakala nikel dipilih sebagai pemangkin kerana berupaya menumbuhkan CNS dengan kepadatan yang tinggi dan ia juga merupakan bahan anti karat. Dua parameter dikaji dalam bahagian ini iaitu ketumpatan arus (1-30 mA/cm^2) dan tempoh masa penyaduran (10 min-60 min). Semua sampel dicirikan menggunakan Mikroskop Electron Imbasan (SEM), Tenaga Serakan Sinar-X (EDX), Pendarkilau Sinar-X (XRF) dan Mikroskop Daya Atom (AFM). Untuk bahagian kedua, pertumbuhan CNS menggunakan Pemangkin Kimia Pemendapan Wap

(CCVD) di mana, gas asetilena telah digunakan sebagai pelopor karbon selain daripada metana. Tiga parameter telah dikaji dalam bahagian ini, suhu tindak balas (400 ℃ - 800 ℃), kadar pengaliran pelopor karbon (10-30 sccm) dan tempoh masa tindak balas (5 min-40 min). Semua CNS yang tumbuh dicirikan menggunakan SEM, Mikroskop Penghantaran Elektron (TEM), Analisis Permeteran Graviti Haba (TGA) dan Spektroskopi Raman. Daripada kedua-dua bahagian, tahap prestasi pemangkin nikel tersadur di atas substrat kuprum terhadap pertumbuhan CNS dengan ketumpatan dan kualiti tinggi adalah optimum di atas pemangkin kuprum terelektrosadur nikel yang mempunyai saiz bijian kecil, nipis, meliputi sepenuhnya dan keseragaman tinggi iaitu 1mA/cm^2. Pertumbuhan terus CNS telah berjaya dilaksanakan ke atas pemangkin nikel tersadur pada suhu pertumbuhan yang rendah di mana keadaan CCVD adalah optimum dalam menghasilkan CNS yang berkualiti dan berketumpatan tinggi adalah pada suhu tindakbalas, 600 ℃, 40 minit masa tindakbalas dan 30 kepada 100 sccm kadar pengaliran asitilena kepada nitrogen.

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ABSTRACT

Since the inventions of CNTs by Iijima in 1991, carbon nanostructure (CNS) in which consists of carbon nanotubes (CNTs) and carbon nanofibers (CNFs) has great attentions among researchers due to the extraordinary properties of this material. A lot of research activities and new findings regarding the potentials of CNS were explored from time to time. One of the potential CNS is it can be used as thermal interface material (TIM) and applied in electronic devices due to high thermal conductivity of this material. Thus, this research is focusing on the synthesis of high quality and density of CNS directly on the platform at low growth temperature towards the potential of CNS for future application as TIM. The first part of this study was the preparation of the heat spreader by electroplating method prior to the growth CNS. Electroplating method was used to coat active metal catalyst, nickel to the copper as substrate and copper was selected as the substrate due to high thermal conductivity of this material whereas nickel is used as the metal due to the ability to grow higher density of CNS and corrosion resistant. Two parameters were studied in this part which was current density (1-30 mA/cm^2) and plating time (10 min-60 min). The samples were characterized using Scanning Electron Microscopy (SEM), Energy Dispersive X-Ray (EDX), X-ray Fluorescence (XRF) and Atomic force Microscopy (AFM). For the second part of this study is the growth of CNS via Catalytic Chemical Vapour Deposition (CCVD) where acetylene was used carbon precursor instead of methane. Three parameters were studied for this part, reaction temperature (400 ℃ - 800 ℃), flow rate of acetylene (10-30 sccm) and reaction time (5-40 min). All CNS growth were characterized using SEM,