INSTITUTO TECNONÓLOGICO Y DE ESTUDIOS SUPERIORES DE MONTERREY

MASTERS THESIS PROPOSAL

Fabrication of graphitic-carbon suspended nanowires through mechanoelectrospinning of photocrosslinkable polymers

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Supervising Committee

The committee members, hereby, recommend that the proposal by Antonio Osamu KATAGIRI Tanaka to be accepted to develop the thesis project as a partial requirement for the degree of Master of Science in Nanotechnology (MNT).

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Declaration of Authorship

I, Antonio Osamu KATAGIRI Tanaka, declare that this thesis titled, "Fabrication of graphitic-carbon suspended nanowires through mechanoelectrospinning of photocrosslinkable polymers" and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Signed:

Date:

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Abstract

Antonio Osamu KATAGIRI Tanaka

Fabrication of graphitic-carbon suspended nanowires through mechanoelectrospinning of photocrosslinkable polymers

Carbon nano-wires are versatile materials composed of carbon chains with a wide range of applications due to their high conductivity. Regardless of the high interest in the implementation of carbon nano-wires in several applications and devices, no feasible processes have been developed to fabricate carbon nano-wires with spatial control at a reasonable cost. Carbon nano-wires have been fabricated with the use of a photoresist, but little is known about polymers that can produce more conductive carbon nano-wires after pyrolysis. Various polymer solutions have been tested in near field electrospinning (NFES) and photopolymerization separately, however, few have been tested for nano-wire fabrication purposes through pyrolysis. The intention behind the thesis proposal is to implement rheology analyses of different polymer solutions to determine if they can be easily electrospun at low voltages and then fabricate nano-wires with them. This thesis work arises from the need to test a greater variety of polymers with the goal to design a polymer solution to fabricate carbon nano-wires with better conductivity than the current SU-8 polymeric nano-fibers. The research process will include the design of polymer solutions that can be electrospun, photopolymerized, and then pyrolyzed into conducting carbon nanowires. On the other hand, it is intended to engineer a newly designed polymer solution to achieve mass scale manufacturing of conductive carbon nano-wires in an inexpensive, continuous, simple and reproducible manner as central components for nano-sensors.

keywords: nanotechnology, carbon, nano-wires, electrospinning, NFES

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List of Abbreviations

CEM	**C**ampus **E**stado de **M**éxico
CNWs	**C**arbon **N**ano-**w**ire**s**
DC	**D**irect **C**urrent
EMS	**E**lectro**m**echanical **S**pinning
FFES	**F**ar **F**ield de **E**lectro**s**pinning
ITESM	**I**nstituto **T**ecnonólogico y de **E**studios **S**uperiores de **M**onterrey
MA	**Ma**ssachusetts
MEMS	**M**icro**e**lectro**m**echanical **S**ystems
MNT	**M**aestría en **N**ano**t**ecnología *(Master of Science in Nanotechnology)*
MTY	**M**on**t**erre**y** *or* Campus **M**on**t**erre**y**
NFES	**N**ear **F**ield de **E**lectro**s**pinning
USA	**U**nited **S**tates of **A**merica
UV	**U**ltra**v**iolet

List of Symbols

Symbol	Name	Unit
ω	angular frequency	rad

1 Carbon nanowires research developments in terms of published papers, synthesis and production

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2 Fabrication Process Selection of Conductive Carbon Nanowires

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3 Near-Field Electrospinning as an Affordable Way to Gain Spatial Control

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4 Compatible Polymer-Solvent Combinations for Near-Field Electrospinning

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5 Fabrication of Polymeric Fibers through Near-Field Electrospinning and Photopolymerization

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6 Fabrication of Conductive Carbon nanofibers by Pyrolysis of Polymeric Fibers

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7 Comparison of the Carbon Fibers Obtained Against SU8-based Carbon Fibers

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