

UNIVERSITI TEKNOLOGI MARA

**UTILIZATION OF FERMENTED GLUTINOUS
RICE AS STARTING MATERIAL FOR CARBON
NANOTUBES SYNTHESIS USING THERMAL-
CVD**

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Thesis submitted in fulfillment of the requirements
for the degree of
Master of Science

Faculty of Applied Sciences

JUNE 2012

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of University Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

A new approach of starting material for CNTs preparation has been introduced in this research. The fermentation conditions of glutinous rice have been optimized to ensure it was suitable to be used in Two-system Thermal Chemical Vapor Deposition (Thermal CVD) method. The prepared CNTs were characterized using Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR) and Raman spectroscopy. In optimizing the fermented glutinous rice, inoculum amounts were varied from 1 - 11 wt. % of the glutinous rice, meanwhile the incubation time was ranged from 2 to 8 days period. Incubation temperatures were examined from 10°C up to 50°C. It was concluded that the optimum inoculum amount in fermented glutinous rice for CNTs synthesis was 1 wt. % and it should be inoculated for 2 days at 30°C of incubation temperature. As such, the optimized fermented glutinous rice was further used for the optimization of Thermal CVD system. Furnace 1 was ranged from 300°C to 500°C with 50°C interval, meanwhile furnace 2 temperature was examined from 600°C to 900°C with the same interval. The fermented glutinous rice was fully vaporized at 450°C in furnace 1, meanwhile the deposition temperature (furnace 2 temperature) was best at 750°C. Catalyst preparation also plays an important role for CNTs synthesis. Three types of catalyst preparation was introduced; Seeded, Floated and last but not least Seeded-Floated preparation. Nickel was used as Seeded catalyst as it was reported to be the fastest metal catalyst diffused by carbon thus had promoted the catalytic activity and carbon segregation in CNTs synthesis. Meanwhile ferrocene was used for Floated catalyst preparation due to its volatile organometallic complex which was suitable to make CNTs in large scale using CVD method.

ACKNOWLEDGEMENTS

First and foremost I would like to express my utmost gratitude to my supervisor Associate Professor Dr. Mohamad Rusop Mahmood from NANO-SciTech Centre, Institute of Science for his guidance and encouragement given during the period of this research. Sincere thanks goes to my co-supervisors, Prof. Saifollah Abdullah and Prof. Azni Zain Ahmed from School of Physics and Material Studies, Faculty of Applied Sciences for their endless supports and advice.

My sincere gratitude is extended to staff and laboratory assistants of Mechanical Engineering Laboratory, especially to En. Mohd. Rahimi Abdul Rahman (Technician) and En. Hayub Ta (Assistant Science Officer) from Material Science Laboratory, Faculty of Applied Sciences for their assistance in using FESEM. I also want to thank Pn. Nurul Wahida Aziz (Assistant Science Officer) and En. Mohd Azlan Jaafar (Technician) from NANO-SciTech Centre, Institute of Science for Raman characterization and last but not least to Chemistry Laboratory, Faculty of Applied Sciences for FTIR measurement.

Special thanks to Biotechnology Research Centre, Malaysian Agricultural Research and Development Institute (MARDI) for the inoculums supplied during this research. I am really indebted to my colleagues at NANO-SciTech Centre and Solar Cell Laboratory for their continuous supports and ideas in pursuing this research. To my beloved husband, En. Mohd Rosli and parents, En. Samsudin and Pn. Tengku Suraya, your strength builds mine. Your endless love and prayers has done wonders for ever since I can ever say.

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