

University of Groningen

Selecting semiconducting single-walled carbon nanotubes by polymer wrapping

Gomulya, Widianta

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2015

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Gomulya, W. (2015). *Selecting semiconducting single-walled carbon nanotubes by polymer wrapping: Mechanism and performances*. University of Groningen.

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Acknowledgement

Finally! It has been 4 years of an enthusiastic, joyful, and wonderful PhD journey. And at this point, the journey is at an end with the completion of this thesis. There are many people that helped me to achieve this milestone, and I would like to thank all of them.

First of all, I would like to express my deepest gratitude to my supervisor, Prof. Maria Antonietta Loi, for her guidance and supervision during my PhD. Maria, you accepted me into your group, where I really enjoyed to work and where I have learnt many things about so many different topics. Thank you for introducing me to the field of spectroscopy, and for helping me with generating experimental ideas, paper writing, presentations for conferences, and to meet and know scientists all over the world, which added quality to my PhD experience. Thank you for your patience with me.

I would like to express my gratitude to the members of the reading committee for spending much time reading and evaluating my thesis: Prof. Jana Zaumseil, Prof. Michael Arnold, and Prof. Justin Je. Your comments and corrections have been fundamental to improve the quality of my manuscript.

During my research I had the possibility to collaborate with many people: Prof. Ullrich Scherf, Dr. Sybille Allard, Martin Fritsch, Nils Fröhlich, and Stefan Jung, thank you for synthesizing the polymers; Prof. Maria Cristina dos Santos and Elton Jose Figueiredo de Carvalho, thank you for providing the carbon nanotube simulations, which gave a fundamental support to my experimental results; Prof. Andreas Herrmann, and Pavlo Gordiichuk, thank you for helping me with the AFM imaging. This thesis would never have been completed without the help I have received from you all.

I also would like to thank Prof. Andrea Mura for teaching me how to build an optical setup. It was a pleasure to work with you; I have learnt many things through your research experience and also your stories about Cagliari.

A special mention goes to my paranymphs: Angela J. Kumalaputri and Lai Hung Lai, thanks for accepting to be my paranymphs, and for helping me with my defense preparations. Ela, many thanks for the stories, your listening, your sharing, and all help (and also the nice food!) during the last year of my PhD. The trip to Spain was

very exciting. Thanks for so many collectible coins, I hope you can travel even more, so that I can get even more coins :). And Lai Hung, also my housemate, thank you for your support and help during my PhD. I gained a lot of experimental knowledge from you. And we travelled a lot, our time together was very amusing (maybe except for the biking :)). Also thanks for the final checking of my thesis.

A sincere acknowledgement is dedicated to thank Renate Hekkema, our group secretary, for helping me with all the paper work, and our great technicians: Arjen Kamp, Frans van der Horst, and Jan Harkema. The group would have hard time survive without your technical support. Arjen, you are very humorous and all your funny stories about camping, backpacking, and travelling made the lunches in the coffee room always so nice .

I would like to thank Krisztina Szendrei, Jia Gao, and Satria Zulkarnaen Bisri for being my daily supervisors. Kriszty, I learnt so many things from you during my master; from the way of working in the clean room, to how to make a very good solar cell (I guess still one of the best in our group). Jia, thanks for introducing me to all the things related to the carbon nanotubes at the beginning of my PhD, and for showing me how to work in the laser lab. Without your help, I think my PhD would have been much more difficult. Kang Izul, thanks for sharing with me your knowledge me about transistors, for showing me how to work as a PhD, and for your help in improving my writing skills.

Alex, Dorota, Simone, and Claudia, we did not work a lot together, but thank you for sharing your experience and knowledge: how to work in the laser lab, clean room, and research discussions.

Marianna, it was a great pleasure to meet you. We shared sooo many things: an office, the life in the laser lab, and also some travelling together. It was always funny to hear someone singing in the laser lab! Also thanks for sharing with me much important information and for helping with the preparation of my PhD thesis and defense. You were also one of my paronymph candidates, but unfortunately, Lai Hung “beated” you.

I would like to thank all the current members of the P-OE group. It was always very nice to be one of you. We shared a lot of fun, friendship, and also knowledge. Vlad and Jorge, together we were also members of the nanotube sub-group, thank you for your collaboration, and for all the work we did together. Vlad, we attended to many SWNT meetings together, and I also enjoyed our discussions about gadgets & Ukrainian politics/stories. Jorge, I really enjoyed our discussions about the working mechanism

of the polymer wrapping, and our chit-chat about several other topics. I wish you guys all the best, and I am sure you will achieve a lot, keeping strong the SWNT sub group.

Insan, thanks for our many chit-chats and also research discussions, and good luck with your research in Japan. Many thanks to Musty for helping with proof reading many of my papers and the thesis manuscript. It was also very pleasurable talking about gadgets and other topics with you. A special thank goes to Bart, for translating the summary of my thesis to Dutch, and also for final proofing of the thesis together with Mark. Furthermore, I would like to thank other members of the P-OE group: Hong Hua, Shuyan, Daniel, Sampson, Artem, Simon, Dima, and Natasha. Many thanks also to the members of the other P-OE sub-group: Jan Anton, Davide, Niels, Tejas, Solmaz, Nutifafa, Azi, and Jian.

It was a pleasure to work with my students: Thijs, Misha (and also Jorge). Thank you for your hard work helping with some of my projects. I hope I have been a good supervisor for you, and I hope what you have learnt here can be useful for your future. Other students worked in our group; Wytse, Matthijs, Raissa, and Nisrina: it was very nice to meet you, and I wish you all the best for your future career.

My life in Groningen would not be so pleasant without the friendship of all my fellow Indonesians. Bintoro, my best buddy, and my former housemate: we very often went shopping together, shared countless PhD and life problems, and most importantly, we shared the cooking schedule! It was a great pleasure to get to know you, I hope we can keep our friendship beyond Groningen, and I hope you will finish your PhD soon.

Many thanks to my “playmates” and “travelmates”: Kenzie, Ocha, Rieza, Doti, Putri, Amirah, Auliya, Ysbrand, Han Han, with whom I shared so many exciting moments with, which would end, the most of the time with a nice dinner :). The Christmas holidays, the other vacations, and all the times we spent together were very joyful. Also all of the “gossip” and chit-chat were really entertaining. I hope our friendship will last forever. Thank you also for supporting me during my defense preparations. A special thanks goes to Kenzie who introduced me to board games. Can I have half of your collection? :D

I had a lot of fun with the board game fellows: Daniel, Dani, Meta, Edo, Nisa, Oline; the students from the RuG-ITB sandwich program: Irfan & Liza, Fainan, Echa, Devi, Iqbal & Eryth, Robby & Lia, Muiz & Sri, Wahono & Dini, Alia & Izul, Faizah & Pandji, Astri, Florence, Azis & Amalina, Ali, Dina, Masyitha.

Selecting s-SWNTs by polymer wrapping: Mechanism and Performances

I cannot forget to mention the Planetenlaan families: kang Amel & teh Puti (Meisya), and mas Donny & mbak Nieke (Adziya), thank you for hosting me for almost 3 years. I always felt at home with you! kang Iging & Desti (Daanish), mbak Tiur, mbak Laksmi & beli Kadek (Vina, Ditta), Sofi, Pak Asmoro & Bu Asmoro (Adi, Iva, Rivat), I have had a lot of fun whenever we gathered.

For other friends: mas Yayok & mbak Lia (Keisya & Kathya), Auliya & Nelly, pak Hengki P., mbak Puri, Susan & Bino (Anika), Yusuf, Ria, Louis, pak Henky M., Cyndy, Ivan, Martin, Jenny & ko Jeffrey, ka Roga, bu Ima, Fean, Adel, mbak Ira, mas Ronny, mas Kus, mbak Astri F., Vessa, Ali & Yosi, Habib, Salma, Almas, ka Laura & ka Jerome, Harison, mas Pras, bang Mangarah, ka Aster, Samuel, mbak Ika & Paul, tante Tini & om Fred, tante Hanna, mas Archi, mbak Arie, Vino, David, Isabelle, Schumann, and many others whose names are not mentioned here, thank you for making my stay in Groningen more colorful.

Finally, my deepest thought goes to my beloved family, whom I dedicated this thesis to: Mama, Wei Thing, Weina, Weiyung, thank you for all the support, care, and prayers. Mama, thanks for everything you have done for me, I know there is nothing I can do to repay your kindness. I hope I can make you proud of me. Wei Thing, thank you for taking care of mama during my absence in Indonesia. I really miss you all, and I am looking forward to see you all, soon.