

University of Groningen

The power of polymer wrapping

Salazar Rios, Jorge

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:

2018

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

Citation for published version (APA):

Salazar Rios, J. (2018). *The power of polymer wrapping: Selection of semiconducting carbon nanotubes, interaction mechanism, and optoelectronic devices*. 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.

Acknowledgements

It was a bit more than seven years ago when I visited Groningen for the first time. With the date for my defence coming closer and closer, an exciting journey of personal and professional developments is coming to an end, next to the end of my time in Groningen. This whole journey has been enjoyable and productive thanks to many good people that I have had the luck to run into during my entire life.

My PhD thesis is the result of the work of many people that have been helping and supporting me, professionally and personally, and I would try to thank some of them. I apologize in advance if for any reason I forget to mention someone, it would not mean that I do not appreciate the input from that person. It would just mean that sometimes, I am clumsy in that way.

I would like to start expressing my gratitude to my promotor and supervisor, Prof. Maria Antonietta Loi. Maria, I enormously appreciate all of your support and guidance during the last five years, which includes my master and PhD project. I feel like despite how busy you were, you always took the time to help me and you always do your best to make my life and the lives of my colleagues easier. I think your skills as a researcher are extensive, but beyond that what I admire the most are your skills as leader and manager. I cannot imagine how big the challenge is to handle many PhD candidates with many different ambitions and different personalities. I guess the key is to be a bit of a therapist and it is something you understand very well. I have learned a lot from you, and I feel honored and grateful for being part of the POE group.

I also want to thank my co-promotor Prof. Kees Hummelen for letting me be part of the FOM focus group. I really appreciate your flexibility and desire to help me anytime you had the chance. I also want to thank you for checking my samenvatting.

I sincerely want to thank Prof. Petra Rudolf, Prof. Enzo Menna and Prof. Yong-Young Noh for taking time from their busy schedule to evaluate this thesis, approve it and give me the corresponding feedback.

Petra, besides thanking you for being part of my reading committee, I also want to thank you for being my student advisor during the first year of the Top Master. I feel very thankful and lucky to have had a student advisor with such kindness. Your willingness to help me made my whole experience in Groningen much easier. There are many things you have done for me, and it would be difficult to list all of them, but I especially remember when you and Valerio joined me to visit a house that I wanted to rent because as a master student I could not sign a rental agreement.

From the professional point of view, I want to thank Dr. Sybille Allard and Prof. Ullrich Scherf for providing as many conjugated polymers as we needed during the whole project. Prof. Maria Cristina dos Santos for the interesting discussions and all the simulations she performed for us. Dr. Mario Caironi for all device experiments performed in his group which were an important input for our research. Dr Peter Nirmalraj for the nice STM images of our samples. Finally, I want to thanks Prof. Antonio Facchetti for providing us materials from his company Flexterra (former Polyera).

I want to thank Renate for the administrative help, you always made my life easier when I needed to go through a troublesome administrative process. Jan Peter, as PhD coordinator you always tried to help me and you were always open to talk; those were things I really appreciated. Teo thank you for your technical support and organizational skills, fish Friday is a huge asset for the group. Arjen, I want to thank you for all the technical support, and besides that I want to thank you for your fantastic personality. You make the lunchtime highly entertaining; your party mood is something I would never forget, besides that your openness to discuss any topic is remarkable and a quality that I appreciate sincerely.

I would also like to say thanks to all of my colleagues, the current and the former ones. I think a huge part of a successful PhD experience is to have a nice boss and nice colleagues. I always felt comfortable sharing time with all of you, and I always felt like I could count on you whenever necessary.

I would like to start addressing the CNT team. When I arrived at the group for my master project, Widi was my daily supervisor. I want to thank you for your patience, your openness to share knowledge and our discussions. Even more important than that, I very much appreciate your supportive attitude and peacefulness.

At the same time, Vlad was working as part of the group. After some time his help became crucial for my project. I cannot recall how many devices you prepared for me. In the process of working together, he also turned into a terrific friend. Vlad, you are a really easy-going guy, and you were always in for my crazy ideas, even when I felt like having a shot downtown at 23:00 on a Monday evening. I also enjoyed your visit to Colombia very much, and I was pleased my family could meet you. I know I can always count on you and I hope you know that you can always rely on me.

After a while, Wytse joined the CNT team. I knew you are a really kind person, and after interacting more often with you I realized that you are always there to help everyone who might need you and you do it with great pleasure. Wytse, many thanks for all your help all the time! It would be a bit too long to enumerate all the situations, but I want you to know that I have them present in my mind. Just to mention one, thanks for translating the summary of this thesis from English to Dutch.

In the last stage of my PhD, Ervin joined the group as a master student. I did not imagine how invaluable his help would be to finish my PhD smoothly. Your hard work, knowledge, friendliness, and willingness to help, made our time working together

extremely pleasant for me. I was delighted to write the speech for your master graduation, where I could share with you my thoughts a bit more in detail.

The last months, two new master students joined the CNT group. Sietske and Hilbert, it has been great to have you around. Both of you are very nice people, and it is delightful to see how well you fit into the dynamics of the POE.

Now going from the small CNT group to the big POE group, I want to thank all the former colleagues. Their presence was extremely valuable to keep a nice atmosphere during the working days. Marianna, Satria, Insan, Lai-Hung, Luna, Solmaz, Davide, Irene, Bauke thank you for making the POE an enjoyable place and hope you are doing great in all your current projects.

From the current group, I want to thank everyone, and I want you to know that from each of you I received something nice during our interactions.

I want to start with Andrea, even though officially you are not part of the group. Your visits and great personality make me feel that you were an extra professor of the POE. I always enjoy your presence and your nice way to communicate with everyone.

Dima, thank you for helping me keep the chemical lab neat and for sharing your knowledge with me. Besides, I enjoyed your random facts every time. It was a pleasure to be your office mate.

Natasha, thank you for all your help on the solar cell project, you cannot imagine how valuable everything you did was to help me finish this thesis. I always greatly appreciate your caring attitude and your desire to help.

Sampson, you always make me laugh inside when you call me Mr. President and our talks were always entertaining. Thank you for drinking beer with me and not minding it too much when I offered you alcohol. The calmness you always transmit is great for the POE group and for our social interactions!

Herman, since you arrived you look like a really kind and easy-going person, your personality makes the interaction with you really easy and pleasant. Thank you for trying to help me every time I needed it, I appreciate it greatly. Thanks a lot for proofreading parts of this thesis.

Musty, talking to you about life is always interesting, I think our point of views are quite similar, and it is always enjoyable to discuss with someone that thinks alike. I appreciate your unique personal style and thanks for sharing your knowledge about perfume with me.

Shuyan, your discipline and hardworking spirit are remarkable. Besides that, you were always very kind to me which I always appreciated. It is really nice that now your kid is living in Groningen, and it was cool I had the chance to meet him.

Hong-hua, you are a really smart, hardworking and friendly guy. Your calm and relaxed attitude was always pleasant. I wish you the best in France! I hope Jie and you will have a great time there.

Artem, since we started to get to know each other a bit better, I always enjoyed having you around. Your unique personality and sense of humor make social meetings more entertaining. Thank you for showing us your nice spirit, and I want to thank you and Ximena so much for the fantastic idea of introducing me to Esmée! I am always going to feel grateful towards you two for that!

Simon, since you arrived to the group, you became the glue to keep da real MVPs together. Thanks to you our social life was quite active and entertaining. Besides that, your puns and sense of humor make the working environment even more fun. In the process of our PhD, you became a really good friend, and I am looking forward to meeting you in Colombia! Thanks a lot for always being willing to help me and thanks for proofreading parts of this thesis!

Mark, I still remember the day I met you when I started my master project. Since moment one it was clear that you are a really likable person. I always appreciate to hear about your way to see life and your approach to handle every situation. Many thanks for taking me to the Knickerbockers, I enjoyed my year there very much and I met all these nice people thanks to you. I always remember that you were the first person that started mentioning my political skills when you were a bit tipsy; now it got viral inside the group. By the way, I always like the timing and style of your comments.

Daniel, there are so many memories and nice moments we share together, it is impossible to list them here. Your visit to Colombia, all the times you cooked for me, our burger times in papa joe's, the last trip to Budapest. During our time in Groningen, you became a great friend and I hope despite the geographical distance we will keep our amazing and unique friendship for life. Thanks for your directness and your willingness to listen to my point of views, and I look forward to our next conversation about life!

Bartolomeo Gerardo Henrique Maria, first of all, thank you for being my paranymph, I know it is a big responsibility, but I trust you deeply. It was always nice to have you as my office mate, to have you around every day made the process of finishing my thesis more enjoyable. Your friendly personality, your sense of humor, your kindness and your way of seeing life always made me feel comfortable around you. Thanks a lot for all the times you helped me using your natural skill to spot details! In the last years you became a great friend and I hope we will keep in contact in the future, I am still in to help you to be a minister someday.

In the POE group we have a second part of the group under the leadership of Jan Anton. I also want to thank all of them.

Jan Anton, I find your personality, politeness, and style to handle situations very interesting and appropriate. Thank you for being always open to talk and make the environment more pleasant for everyone. I want you to know I admire your leadership style and how you handle your students.

Tejas, we started the PhD almost at the same time, and we are getting our degree now almost at the same time as well. In the last years, I got to know you, and I want you to know that I always enjoy a lot our interactions. Your relaxed personality and openness is invaluable. I still remember that usually you were in for my random ideas, even when they involved Latin music events, thanks for that!

Vincent, you arrived to the group just when I slowed down my party lifestyle, for that reason we have not had the chance to party together that much. However, it is really cool to see how energetic you are and how much fun you have at parties. Thanks for all the shots we had together. Besides the party, your laid-back personality makes the interaction with you really pleasant, it is always nice to talk with you.

Azi, you always have a smile and a good attitude, that is something I much appreciate. Thanks for making the environment of the POE more delightful.

Jian, you are always smiling and willing to help others. Thanks for collaborating with Ervin and helping us with materials. It is really nice that your son is now in the Netherlands.

Marten, ever since you arrived to the group, it is evident that your personality fits well. You are easy-going, easy to talk to and always open to join the different plans that are proposed. I think everyone is going to enjoy your presence in the group a lot for the next four years. Thank you for organizing the Karting, it was super cool!

Nutifafa, we met more than six years ago when we started the top master. It has been really nice to have you around, I want you to know I enjoyed the few times that we had the chance to play soccer together a lot. It is always good to talk to you, and it is fun to spend time with someone that likes football as much as I do.

I would like to extend my appreciation to all the FOM focus group members. The meetings were interesting and it was very good to share all the knowledge. I especially remember the trip we had to Eindhoven.

Before starting my PhD, I also did my master in Groningen and several of my former classmates are still around. It has been a pleasure to share the master and PhD experience with all of them.

Rolf, even though you left Groningen a few years ago, it is always nice to see you. I was happy to hear during Eric's defence that your adventure in Germany is going well.

Tadesse, you spent one year in Groningen, but that time was more than enough to turn into great friends. Your support during the first year of the top master is something I will never

forget, you are a great person. I am really happy that even after all these years we are still in contact and I hope at some point we will have the chance to meet in Colombia.

Juan, I was happy to be able to be there at your defence. Your personality always makes all our interactions pleasant. I hope you and your husband will have an awesome and smooth life after the PhD and postdoc experience in Groningen.

Jin, your sweet personality and kindness makes people feel comfortable around you. Even though we did not have the chance to talk that often, every time I ran into you, I was always pleased to know that you were doing well. I wish you the best with your next job experience!

Sid, it was always nice to have a conversation with you because of your calm and sympathetic personality. You are a smart guy, and I admire your hardworking spirit. Your kindness towards everyone is also remarkable. I hope you will find great personal and professional opportunities in your near future.

Malik, you were the first person I met in Groningen, I will never forget our adventure walking all night long in Amsterdam. Also, our struggle trying to follow the enormous steps of Eric. It was really nice to be able to attend your defence, and I am sure you will find many good opportunities to develop your professional career.

Eric, even before I arrived in Groningen you were already helping me, I remember you were the one to start the Facebook group for the top master. During my period in Groningen you turned into a great friend! We experienced so many things together, the ESN weeks, the concerts, your trip to Colombia, among many others. I highly appreciate your friendship and I hope we will keep it strong even after I move away from Groningen. I am really happy you have found Antonijia and I hope both of you will visit me again in Colombia at some point. A big thank you for being my paranymph, I am happy you have gathered a lot of experience in that matter before my defence. I hope you remember that I decided to have you as my paranymph more than four years ago.

Besides all the people that are linked to my studies or the PhD experience inside the university, I also want to thank the many people that I have had the chance to meet in Groningen during the last years.

An excellent way to start with this transition is to thank Olga, who was part of the university and became my friend thanks to an email from Ryan, her supervisor. I remember our lunchtimes and the nice conversations we had when you arrived to Groningen. I want to thank you for making me part of your and Carlo's life. I am really happy I could help him when he proposed to you and to be there at your wedding in Spain. I also want to thank Carlos for the nice conversations and the good times having beer after church.

During my time in Groningen, I have had several housemates, and I want to thank all of them for contributing to my great experience here in Groningen.

First, I want to thank the Plutolaan family for the support during the first year in Groningen. Kvestan, Christine, Pawel, Anna, Marius, Orkhan, Jintao, Bieke, Eline, Mathiue, Flo.

We had so many good times together at the Plutolaan, and the reunions were also always lots of fun! Flo, thank you for always keeping in contact, it is something I appreciate enormously!

After Plutolaan, I moved to the Colombian mansion with Gloria and Johana. Thank you for being my older sisters, for having a lot of patience with me and thanks for all the fantastic moments we shared together. Gloria, thanks for always keeping in contact and I am happy you visited my family in Colombia. Also thanks to you, we formed the cherry sunrise, Luke, Daniel, Marius, Bart, it was great to share time with all of you guys.

Special thanks to Annika and Daniela, you are amazing friends, and I always feel your unconditional support! I am delighted that even after a few years and each of us living in different countries, we always find ways to meet. I want you to know that your friendship means a lot to me and I hope we will keep it alive forever!

Among my housemates, I also need to consider Stefany, your periods as a homeless allowed us to build a strong friendship. It has been amazing to see your development and I am really happy to count you among my friends. Thanks for always being in for my crazy ideas and try to listen to my advice now and then. Keep in mind you can always count on me!

The new member of the Colombian mansion 2.0 was Lionel. It has been really nice to share this journey with you. As a housemate you were always relaxed and tried to keep a comfortable environment at home. It has been a pleasure to see how you have grown as a father and to hear how well Eduardo is doing.

Maryam, you were the first housemate that moved in without being my friend first. Within a couple of weeks you turned into a close friend, and after few months you were already a friend for life! I greatly enjoyed our time living together, and I want you to know that I always feel your support and I hope you feel mine. It was great to see how your relationship with Andres developed and how you two turned into parents. Elena is wonderful! Andres, thank you for your friendship, for all the fun soccer matches and for suggesting Maryam as a possible housemate. To both of you, thanks a lot for all the amazing moments.

I also want to thank my last housemates before moving in with Esmée. Laura and Ailine, many thanks for being my friends and for all the memorable moments we shared living together. I think our different personalities complemented really well. Mi chino, thank you for all the nice conversations, your advice and for following my crazy ideas. Laura, thank you for your patience and flexibility, thank you for all the conversations about life and for all the pieces of advice.

Besides my housemates, I met lots of nice people during my time in Groningen and I would like to mention all of them, because they also turned this experience into an awesome one. Everyone in one way or another helped to make my time in Groningen more pleasant and interesting. I know I am going to forget many names but I am going to try to include as many as I can.

I want to mention the people I met thanks to ESN, for many years they were a crucial part of my social life. Thanks to the Cazzo family. Ilaria, Valeria, Gosia, Ane, Maria, Bart, Catello, Kristine, it was amazing to have the chance to meet you and I will always remember all the fun memories we made together. Rosa, Renata, I am really happy we are still in touch and I want to thank you for keeping me as a part of your life.

I also want to mention the Colombian crew, the ones that already left and the ones that are still in Groningen. It was always great fun every time we had the chance to meet. Thanks to Gaby and Jens, Fifi and Niels, Viviana (Molano), Liliana, Andres (Negro) and Maria, Mitch and Mayra, Jose, Javier (Villamil), Diego, Ana Cristina, David, Alejo, Javier (Gutierrez), Andres (Holguin), Luisa, Ana Maria, Yea, Christian, Gonzalo and Derly. It was a pleasure to share the Groningen experience with all of you and sorry if I forgot any name.

I want also to thank the friends of diverse nationalities I met in different ways. Larisa, Paul, Daniela, Karine, Gayane, Bauke, Thijs, Kieu, Alex, Insa, Linda, Ilian, Nestor, Veselina, Adrian, Nghi, Coty. Thank you for, in one way or another, making me part of your lives at some point.

Yoga and Meditation were an important part of my life in Groningen and helped me during my PhD experience. At this moment I want to thank Suzy for taking me to the Zen boat! Besides that, thank you for all the nice conversations and for sharing your charming personality with the POE group. It was always great to share time with you!

At the Zen boat I met Daphne. Thank you for all the tasty dinners before meditation, our Tuesday routine help me to be disciplined and go to mediation more often. I always liked our conversations about life!

I want to thank all the monks from Zen river Groningen for their guidance and I especially want to thank Helma. Your guided mediation and one to one talks were extremely fruitful for me and helped me to get to know myself much better, thanks so much for that!

Some of my friends in Groningen, joined me at some point to the meditation both. Bianca, Vania, Elsa, thank you for trusting me and sharing that experience with me. I appreciate enormously your friendship and I hope we will keep contact!

I also want to thank Maxi for her Yoga guidance. Your compassionate and lively spirit always made my time in the yoga studio super pleasant.

To finalize with the thanks for the people related with Groningen, I want to thank the Colombian friends that visited me in Groningen at some point. Andres and David, thank you for joining me for my master graduation and for your friendship. More than 10 years ago we started our studies together and afterwards we shared the experience of a PhD in Europe. I feel honored and grateful to count you as my friend. In this group I want to include Daniela. Dani thanks for visiting Groningen while suffering an allergic reaction and thank you for letting me make Andres super drunk.

Marce and Santi, thanks for visiting me in Groningen. I am really happy you are having a good experience in Germany. I still remember how your relationship started during our bachelor. It made me feel happy that a difficult and a bit traumatic math course helped you to end up together!

Diego thank you for joining me on my research for a couple months! It was great to have you in my house and share the Groningen experience with you! Maria still keeps the amazing cartoon you drew in her office.

Pili, thank you for visiting me in Groningen and for traveling in Europe with me. It is always really nice to see you and thank you for the patience you had every time you visited me!

Boflo and Cifu, it was great to have you in my house and had the chance to travel and party a bit together. You are friends for life and I was happy to share time with you in Europe!

Manri, thank you for spending King's day in Groningen and thank you for helping Renata! Your presence here was a way to feel the whole Tindercats crew closer and feel that in a way I shared the Groningen experience with them!

Silvis, thank you for all the times you visited me. It is always great to see you! It is great that you could live for a while in the Netherlands and I happy we could meet just before you went back to Spain.

Zulma! It was great to have you in Groningen and to have the chance to share time with you and Esmée's family at the same time. I loved our conversations about life and I hope Esmée and I will have the chance to visit, Nata, Juanca, tio and you in the near future. I want you to know that I always feel your support from the distance!

Juancho, thank you for being my best friend, for always being there, for spending our first Christmas together in Europe. I still remember clubbing in Groningen that New Year's Eve. It is impossible to summarize our friendship with words but I know you know that I am always going to be there for you and I know I can always count on you!

The acknowledgements are coming to an end and now I want to go into the thank you's for the more important people in my life, my family.

I want to start with Esmée, amor de mi vida thank you for being in my life, for your unconditional support and love, for all the happiness and learning experiences you bring to my life all the time. Thank you for being the editor of huge part of this thesis! I am looking forward to sharing my life with you and for our adventure in Colombia.

I also want to thank Esmée's family, Arja, Wil and Dominick. You made me feel welcome and at home since the first day I visited your house, and I quickly felt that I am part of the family. Thank you for your love and for supporting all our decisions!

Many thanks to my family in Colombia. Ligia, Andres, Martha, Antonio, Diego, Conde, Mercedes, Sandra, Fabio, Beatriz, Sofi, Anto thank you for all the support from a distance! Dad, mom and Daniel, thank you so much for the unconditional love that you have always given me. That love has been an extremely important engine throughout my life and of course during my entire stay in Groningen.

To finalize, I want to dedicate this thesis to the families of Daniel Pineda y Andres Felipe Rojas. They were two high school friends who died in a car accident and in a plane accident while I was in Groningen. The moment their life ended had a huge impact on me and allowed me to put life and situations in a broader context. In that way, I could appreciate more what is really important in life. I want to share with the two families that I always have them present on my mind and that those two tragedies were a huge learning process for me.

Ahora voy a cambiar a español porque quisiera que los dos últimos párrafos estén en español. Quisiera agradecer a mi familia en Colombia, Ligia, Andres, Martha, Antonio, Rosi, Diego, Fabio, Beatriz, Sofi, Anto gracias por todo el apoyo desde la distancia! Papá, mamá, Daniel muchas gracias por el amor incondicional que siempre me han demostrado, ese amor ha sido un motor extremadamente importante durante toda mi vida y por supuesto durante toda mi estadía en Groningen.

Para finalizar quiero dedicar esta tesis a las familias de Daniel Pineda y Andres Felipe Rojas, ellos fueron dos amigos de Colegio que murieron en un accidente de tránsito y un accidente aéreo durante mi estancia en Groningen. Los momentos en que sus vidas se extinguieron fueron muy impactantes para mí y me permitieron poner muchas cosas en contexto para así valorar lo que es verdaderamente importante. Quiero compartir con las dos familias que siempre tengo presente a sus seres queridos y sus tragedias fueron una experiencia de aprendizaje enorme para mí.