



## UvA-DARE (Digital Academic Repository)

### Organotin photoresists for extreme ultraviolet lithography

Zhang, Y.

**Publication date**

2019

**Document Version**

Other version

**License**

Other

[Link to publication](#)

**Citation for published version (APA):**

Zhang, Y. (2019). *Organotin photoresists for extreme ultraviolet lithography*.

**General rights**

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), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

**Disclaimer/Complaints regulations**

If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: <https://uba.uva.nl/en/contact>, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.

# Acknowledgement

---

It has been more than 4 years since the first day I started my PhD in the Netherlands. Now it comes to the end with a mix of excitement and sadness. It's one of the most exiting and unforgettable moments in my life. Meanwhile, it comes with sadness. The sadness is because it's also the time to say goodbye to super you, my dear friends, colleagues and supervisors. You made my life in the Netherlands enjoyable and meaningful. I cannot finish my PhD without the guidance and assistance from many of you. For this, at the end of this thesis, I would like to express my gratitude to all the people I had pleasures to meet and to work with.

First of all, I would like to express my deepest gratitude to my supervisor Prof. Fred Brouwer for offering me the opportunity to pursue my PhD degree in the Nanophotochemistry group. I still remember on the first day of my PhD, you picked me up at Schiphol airport at 5 a.m. I have felt so lucky that I get the chance to work with such a nice supervisor since that moment. Every time I jumped into your office, you were always patient to answer all my questions. Whenever I met difficulties, you always encouraged me and gave me your brilliant advice to shape my way of thinking critically and analytically, which benefitted my research work in the past and will definitely benefit my rest of life. You helped me to identify my character strengths and weakness and to know myself better. Your guidance over the past four years indeed helped me to become a better person.

I would like to express my special thanks to Dr. Sonia. You are the strongest girl I have ever seen, both physically and mentally. Your valuable suggestions, comments and guidance encouraged me to learn more day by day. You can always find the interesting parts in your life and share them with us. You and your funny stories always inspired me at the hardest moment during the past four years (If you write a book on your funny stories, I definitely would like to buy one☺). It's my honor to work with you.

I would like to acknowledge the help provided by my co-promotor Prof. Paul Planken. I also wish to express my deepest gratitude to Prof. Bas de Bruin, Prof. Moniek Tromp, Dr. Stefania Grecea, Prof. Wybren Jan Buma, and Dr. Yasin Ekinci for reviewing my thesis and participating in the defense committee. Especially Dr. Yasin, without the support of your amazing and unique tool (EUV interference lithography), I cannot finish my PhD project.

I wish to thank all my colleagues at ARCNL. It has been so nice to join this big family. Marjan and Joost, thanks for your endless efforts to make every amazing

event possible in ARCNL. Whenever I need your help, you're always ready to solve any problem at the first time. I would like to thank Romy, Rosa and Cathelijne for all your kind help, your patience and strong support. I also give my special thanks to previous and current group members both from Nanophotochemistry and EUV photoresists group. Jarich, I appreciate your efforts involved in this project. You're a patient person and thank you for providing all kinds of our magic cages on time. I really enjoyed the four years' cooperation with you. Especially, thanks for your help with the Samenvating. Lianjia, my lovely sister, you always cook nice food, especially the green bean cake you made for me. I enjoyed all the free chats about science and life during our teatime and during all the beamtime trips in the past 2+ years. Olivier, you're always full of energy and ready to work with enthusiasm, which inspired me a lot. Neha, I enjoyed your milk tea so much. Najmeh, I'd like to thank you for your kind assistance with beamtime. Hero Ivan, I enjoyed the cooperation and all the discussion with you. Thank you for your patience and I'm happy that you enjoyed your trip to China. Robbert, I indeed like your cooking. The cake you baked and the professional Chinese hotpot you made were so delicious. Moreover, you're always there to help everyone. Aniket, everytime I came across a problem with AFM, you were the first one coming into my mind. Thank you for your kind help. Sander, you're always there, quiet and patient, being prepared for all the questions and for providing strong support for all the facilities in the lab. Maarten, Zhichao and Lotte, I'm not professional on supervising students, thank you for your patience, understanding and cooperation. It's my pleasure working with you, goodluck for your PhD programs. Bruno, you are my first friend in the Netherlands, without you I cannot adapt to the new environment so fast. Kevin, I really enjoyed the cooperation with you, and thanks for your contribution to this project, please help convey my gratitude to Qian, I enjoyed her cooking. Niklas, you showed me the way to work with XPS, I appreciate your kind help at the beginning of my PhD. I would like to thank Reinout, you are always patient to answer all of my questions and to solve all the problems on XPS, and it's so nice to work with you. I am also grateful to all my colleagues at ARCNL, Wenqian, Sandra, Daniel, Mees, Jeremy, Hans, Martijn, Eline, Kendra, Unnati, Luuk, Christian (AMOLF), Johannes (AMOLF), Pavel, Mengqi, Feng-Chun, Ruben, Victor, Peter, Stephen, Bo, Oscar, Thomas, Vanessa, Randy, Tiago, Hao, Renfeng, Jan, Cristina, and all my colleagues from support groups, and etc. for every wonderful moment during the past four years in my memory.

I'm glad to join Molecular photonics group at UvA. I would like to express my gratitude to all the group members. I would like to thank Prof. Wybren Jan Buma, Prof. Sander Woutersen, Dr. Rene Williams and Prof. Hong Zhang for your kind help, comments and advice on my project. I would like to express my special thanks to Michiel and Hans for your patience and strong technical support for all the

experimental facilities in the lab. And Michiel, I really enjoyed your paella. I would like to thank Mina, what you did made me feel so warm when I first came to the Netherlands. I would like to thank Dina, I enjoyed every chat with you. You're a patient person always with a smile on your face. I'm grateful to all the group members: Bert, Benjamin, Roberto, Mark, Floor, Steven, Tomislav, Tatu, Luuk, Maximilian, Hernan, Wim, Elena, Aylin, Marije, Yorrick, Janita, Marco, Celine, Ruben, Imme, Aishwarya, Thijs, David, Adriaan, Charlotte, Threes, Jeroen. On my first day in MP group, I was introduced to the "Chinese Mafia" leading by Hong with members Dongdong, Hung-Cheng, Fei, Yadan, Rafeal, and with new members Yansong, Jing Zuo, Yanni, Langping, Jiayun, Zhen Qu, Angela, Pengtao, Luting, Si Shen. I really appreciated your support both in scientific work and in daily life during the past years.

I also received significant support from other organizations. I would like to thank Bob, Dimitry, Andries and Hans from AMOLF/Amsterdam Nanocenter for your professional support with all the training and with problem solving of all the facilities; Michaela, Dimitrios and Roberto from Advanced Lithography and Metrology group at PSI for providing comprehensive support and for helping us get fruitful results; Milos, Mina and Thomas from Molecular Nanoscience group at PSI for providing assistance in XPS measurements; Fredrik and Andreas from Uppsala University, Ruslan and Erika from PM4 beamline, Roberto from HIKE endstation for the support during the beamtimes at BESSY; Danilo and Ivan from IMEC for the support with outgassing experiments and all the valuable advice for my project; Wim, Sander and Claire from ASML for all the nice advice, comments and discussion during the past years.

I wish to thank my master supervisor Prof. Nae Yoon Lee and Dr. Loan Trinh, who offered huge support during my application for the PhD program. Also my heartfelt thanks to many other friends in daily life: Yu Pan, Yuan Gao, Huaqian Leng, Feng Jiang, Lili Kong, Yao Li, Shan Zhu, Bin Sun, Shaotao, Mingchao Wang, Tingting Xia, Meihui Li, Yuliang Liu, Sen Zhang, Yiduo Wang, Xiangmeng Kong, Tiantian, Hainan Zhang, Honglin Chen, Mika etc. And I would like to thank all my friends in China.

I would also like to express my sincere gratitude to my all time friend Minmin, we have been together for more than seven years. Thank you for being there whenever I need you. We spent the most difficult time together in Korea and coincidentally we moved to the Netherlands together. Over the past seven years, we have accumulated so many invaluable memories. I believe our friendship will last forever. With a coincidence that your wedding day is exactly the day that I submitted my thesis, we'll remember this special day together. I wish you all the best.

Last but not the least, I would like to thank my grandfather and grandmother, who have been so supportive all the time and always proud of me. Deep thanks to my parents, brother and all my relatives, without your endless love, I cannot finish my PhD. I would like to thank my husband Lingmin Sun for always standing by me. I'm the luckiest one to have such a special and wonderful man who always understands me. Without your motivation and understanding, I would never be the person that I am today. You encouraged and inspired me with your strength and wisdom. There are thousands of words in my heart that I want to say to you, all of which eventually converge into three words - thanks for everything. Finally, I'd like to thank my two lovely cats, Zhamao and Golden. You're so adorable that help me release a lot of pressure during the past four years.

张宇

Yu Zhang

April 2019