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Destroy, create, transform and sublimate: laboratory dissociation studies on polycyclic aromatic hydrocarbons and analogues

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P Publications

Refereed publications

1. *Reactions of coronene$^{\bullet+}$ photodissociation fragment ions with water in a room-temperature quadrupole ion trap*
Kamer, J., Bouwman, J., 2025, ACS Earth and Space Chemistry, 9, 1017-1029.
2. *IR spectra of cationic 1,5,9-triazacoronene and two of its cationic derivatives*
Kamer, J.[‡], Schleier, D.[‡], Jiao, A., Schneider, G. F., Martens, J., Berden, G., Oomens, J., Bouwman, J., 2024, Physical Chemistry Chemical Physics, 26, 27912-27921.
3. *Photofragmentation of corannulene ($C_{20}H_{10}$) and sumanene ($C_{21}H_{12}$) cations in the gas phase and their astrophysical implications*
Sundararajan, P., Candian, A., **Kamer, J.**, Linnartz, H., Tielens, A. G. G. M., 2024, Physical Chemistry Chemical Physics, 26, 19332-19348.
4. *Laser-induced fragmentation of coronene cations*
Panchagnula, S., **Kamer, J.**, Candian, A., Hrodmarsson, H. R., Linnartz, H., Bouwman, J., Tielens, A. G. G. M., 2024, Physical Chemistry Chemical Physics, 26, 18557-18570.
5. *Photoprocessing of cationic triazacoronene: dissociation characteristics of polycyclic aromatic nitrogen heterocycles in interstellar environments*
Schleier, D.[‡], **Kamer, J.**[‡], Jiao, A., Schneider, G. F., Linnartz, H., Bouwman, J., 2024, Physical Chemistry Chemical Physics, 26, 15547-15558.
6. *Exploring the Scaling Factors for Infrared Modes of PANHs - A Case Study on Cationic 3-Azafluoranthene$^{\bullet+}$ and Protonated 3-Azafluoranthene*
Schleier, D., **Kamer, J.**, Martens, J., Berden, G., Oomens, J., Bouwman, J., 2024, ChemPhysChem, 25, e202300915.
7. *Threshold photoelectron spectroscopy and dissociative photoionization of benzonitrile*
Kamer, J., Schleier, D., Donker, M., Hemberger, P., Bodi, A., Bouwman, J., 2023, Physical Chemistry Chemical Physics, 25, 29070-29079.
8. *Gas-phase infrared spectroscopy of the rubicene cation ($C_{26}H_{14}{}^{\bullet+}$)*
Bouwman, J., Boersma, C., Bulak, M., **Kamer, J.**, Castellanos, P., Tielens, A. G. G. M., Linnartz, H., 2018, Astronomy & Astrophysics, 636, A57.

[‡]These authors contributed equally to this work

C Curriculum Vitae

I was born on Tuesday the 30th of May 1995 in Zoetermeer, the Netherlands. While growing up, I was always interested in the inner workings of devices and solving puzzles in video games. My big dream was (is) to become a scientist who will invent something that would make the world a better place.

During my high-school time at the Oranje Nassau College, Parkdreef, I was mostly interested in math, physics and chemistry. Especially, the latter, as it was incredibly fascinating to me how two clear compounds, when put together, could turn blue or even completely black. However, in order for my brain to comprehend something like that, I had to do some more studying. Although, I had no idea what job I wanted when I would be done studying, so I wanted to study a topic that would be very broad. My physics teacher Hans Janssen used to say: "Nobody who studies physics knows what they want to do later in life, they only know they like physics." So, although my interest in chemistry was big, I eventually choose to pursue a career in physics.

I started my bachelor Applied Physics at the Delft University of Technology in 2013. Unfortunately, I was not in a mentally right spot for such a difficult bachelor, and I switched to Mechanical Engineering soon after starting. When I walked out of my first three hour exam after 15 minutes, I knew I was not (yet) ready for university.

After contemplating if I should continue doing physics, I started a new bachelor Applied Physics in 2014, but this time at the The Hague University of Applied Sciences (HBO). Although it felt like a step down, I was sure I made the right choice this time. During my time here, I got a lot of hands-on experience due to the many (small) experiments we had to do. My first application of this experience was during my internship at NIKHEF, supervised by Eric Hennes and Dr. Boris Boom. This project focused on characterizing the electro-thermal and mechanical properties of electro thermal actuator beams, which were situated on a precise low-frequency micro electro mechanical system (MEMS) accelerometer. NIKHEF was my first introduction into the academic research world and I knew this was the direction I wanted to go in.

For my final internship I was looking for a new project in the academic world. On the bulletin board near the classes, I saw an advertisement for an internship position at the Laboratory for Astrophysics (LfA) at Leiden University, supervised by Dr. Jordy Bouwman and Prof. Dr. Harold Linnartz. I applied, and when visiting I got really enthusiastic about the lab and was luckily selected for the position. For this project I had to investigate the dissociation of coronene cations upon laser irradiation using the Instrument for the Photodissociation of PAHs (i-PoP) – a system that should not be unfamiliar to the reader. During this project I knew: working in a laboratory and doing research is what I am meant to be doing in life. I finished the project successfully and graduated cum laude, bestowing me the title of Engineer (Ing. – university of applied sciences). After finishing I was asked to stay for another two months to prepare the system and help with measurements at the free electron laser for infrared experiments (FELIX) facility in Nijmegen. Already knowing the answer, I asked if I could extend my project and stay for a PhD position. Surprisingly, the answer was not negative, I just had to "do a masters first." So, I did a transition year from HBO bachelor to university and here we went.

I started my masters Applied Physics at Delft University of Technology in 2019 – this time I knew I was ready. As I was well aware of my chances getting a PhD position at the LfA I chose the direction of my masters to have more future opportunities: Quantum Nanoscience. This track had – in my opinion – too much focus on quantum computing, which eventually led me to dislike quantum physics in general. Therefore, for my research project, I was looking for a project that was focusing more on physical chemistry with some quantum aspects. I found a project in Prof. Dr. Herre van der Zant's lab on the electrical molecular features of single molecules in gold break junctions, supervised by Dr. Luca Ornago. As this was a project in a laboratory I again felt I was in the right place. Finally, to finish my masters I had to do an internship at a company that had no direct connection to the academic world. I found a position at Peutz, a consultancy specialized in acoustics, building physics and physics of urban design, noise control and environmental technology. I was supervised by Hans Huizer and worked closely with David Vlieger. My work consisted of doing accurate vibration measurements of passing trains and determining if those were still within the limits given by law, as well as sound measurements at working sites. During my time here, I got a lot of interesting results, which I would have liked to study in more detail. However, a client is – understandably – not interested in this. I realized I missed going into depth and doing research. So, after finishing my masters, which gave me my second title of Engineer (Ir. – university), I asked Dr. Jordy Bouwman and Prof. Dr. Harold Linnartz if I could join the LfA again for a PhD position, which they gladly answered with "yes!"

With Prof. Dr. Harold Linnartz as my promotor and Dr. Jordy Bouwman as my supervisor, I continued the work I started during my bachelor three years ago, although now as a PhD student. Unfortunately, in the 2nd year of my PhD we received the news that Prof. Dr. Harold Linnartz passed away. From this point, Prof. Dr. Xander Tielens became my promotor, for which I am very grateful. In the four years of my PhD, I worked on the i-PoP system and revived a measurement technique that was used often in the past on ion trap system to study not only the dissociation products of PAHs, but also their further chemical processing in the trap. Additionally, I performed measurements with a double-imaging photoelectron photoion coincidence (i^2PEPICO) spectroscopy system connected to the vacuum ultraviolet (VUV) beamline situated at the synchrotron facility of the Swiss Lightsource (SLS), as well as measurements with an ion trap system at FELIX. With both these systems I was able to spectroscopically characterize PAHs and their analogues. During this time I worked in close collaboration with Dr. Domenik Schleier, who was a post-doc at the LfA (now post-doc at the Technical University of Berlin in Prof. Dr. Otto Dopfer's group). The works in this thesis were presented at several conferences and meetings in The Netherlands, Denmark, Germany and the United States of America. During my PhD I supervised one bachelor student (Iris Elfferich) and two high school students (Evgeny Ilin and Louis Nijssen), and I organized the Pre-University Classes for the Astronomy bachelor at Leiden University. In the first year of my PhD, my daily supervisor Dr. Jordy Bouwman, got the opportunity to start his own group at the Colorado University, Boulder in the USA and moved away from the Netherlands. In my 3rd year, Dr. Jordy Bouwman invited me over to work in his group for two months and build a new ion trap system. With all my expertise gained on these systems during my PhD, we were able to build the system and get the first proper signal within six weeks. Something which I am very proud of. Currently, the system is in use by Dr. Jordy Bouwman's PhD student Denver Talley.

Living by the words of my high school physics teacher led me to writing this thesis now. Funnily, I still do not know what I want to do after the defense of this work. However, I am certain I will end up in a good place doing some proper research!

i-pop
MELLES GRIOT
MELLES GRIOT

A Acknowledgements

As everybody will know this work lying before you was not a one man job and many people were in some way or form involved in its creation. Properly acknowledging the contributions of all these people is a task probably more difficult than any PhD research, but I will try and do my best here! If I missed anyone or anything, please note that this is not out of disregard, but purely my own poor memory and oversight.

First and foremost, I would like to thank Jordy Bouwman and the late Harold Linnartz (1965 - 2023) for giving me the opportunity to do my internship at the LfA in 2018 and introducing me into the world of laboratory astrochemistry. Obviously, my thanks goes out to them a second time for allowing me to do my PhD at the LfA as well, and for both of them being outstanding supervisors during my time at the LfA. Also, I want to express my gratitude to Xander Tielens, for becoming my promoter after the passing of Harold, and for the positive words of encouragement in the final stretch of my PhD.

A major part of any PhD is the technical support one receives, which I feel is sometimes overlooked by many. Therefore I would like to thank Aart, Bram, David, Eric, Erik and Huib for their IT support during my time at the LfA and for occasionally lending me their ladder. Also, I want to thank Martijn and Robin for their mechanical support and being able to find a mechanical solution to literally anything. Lastly, Raymond, your electronic expertise have saved me more time than you can ever imagine, thanks for that!

I also want to thank all the people I have worked with at the LfA. Andreas, Carlos, Danna, Domenik, Franciele, Gwen, Helgi, Iris, Jeroen, Jessalyn, Jiao, Julia, Katie, Kirstin, Ko-Ju, Lars, Lina, Marina, Michał, Milan, Morgan, Niels, Pablo, Pavi, Pranjal, Sanjana, Tara, Thanh, Vincent, Will and Xavier, thank you for all the conversations, drinks, puzzles, activities and your many insights and wisdom. I want to give special thanks to Domenik, Pavi and Sanjana for being my close collaborators at the LfA.

During my PhD I also affiliated myself with the Bouwman group at the University of Colorado, Boulder. And when visiting my 'sister' group for two months I had an unbelievably amazing experience. Barney, Denver, Henry, Jordy, Laura, Mia and Rory thank you so much for the warm welcome and showing me the USA lifestyle. I also like to extend my thanks to those outside the group with whom I have had the pleasure of interacting: Angie, Hunter, Kyle, Lily (sorry I did not see you in the back), Maddie, Natalie, Noah, Roberto and everyone at T/aco who kindly welcomed me for dinner one evening – although I forgot your names the moment I stepped out of the restaurant. Also, many thanks to Jordy, Jessey, Wendy and Zoey for the trip to the Rocky Mountains and for organizing my farewell party.

Besides the people in the lab, I also want to thank my (close) colleagues Brian, Dario, Kim, Logan, Łukasz, Margot, Marissa, Marius, Martijn, Milou, Richelle, Rowan, Thijs and Yuze for the fun interactions and conversations.

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Also, I want to express my gratitude to my close family: Co, Marcel, Myria, Paul, Rowan,

Ria and Winny. You might not have understood a single thing I have tried to explain to any of you, but I felt all of your support nevertheless and I know you are all proud of me. Oh, and grandma, it is an actual full-time job, not an education!

This brings me to the most important person to thank, my partner and best friend Nienke. You are my biggest supporter and have never doubted my abilities even when I was at my lowest. Although you also probably never really understood what I was talking about, you were always seriously thinking with me and coming up with solutions to my issues. I do not think you realize how much it helped me forming new ideas and interpretations. You also helped me plenty outside of research and thanks to you I have become a better version of myself. I am so happy you are in my life and I will always cherish your support and trust. Love you!

Finally, it is not just people that can support you in your toughest battles, sometimes it is the non-verbal interaction that can just hit the spot a little better than any conversation will ever do. My last gratitude goes out to all the cute cats and kittens I have petted and/or kissed in my life: Bobby, Bruno, Dirk, Fred, Frog, Hunter, Jimmy, Lillie, Mamino, Maru, Medea, O'Malley, Pi, Poe, Salem, Shiro, Sister Mini, Ted, Tina, Toad and Wolf.