



# A Virtuoso with Molecules

Creativity is as much in demand in research as in music.

**Nuno Maulide** has a wealth of creativity. A chemist working at the **Max Planck Institut für Kohlenforschung (Coal Research)** in Mülheim an der Ruhr, he not only develops new synthetic methods for valuable organic compounds, he also continues to impress people with his piano concerts.

TEXT SARAH-LENA GOMBERT

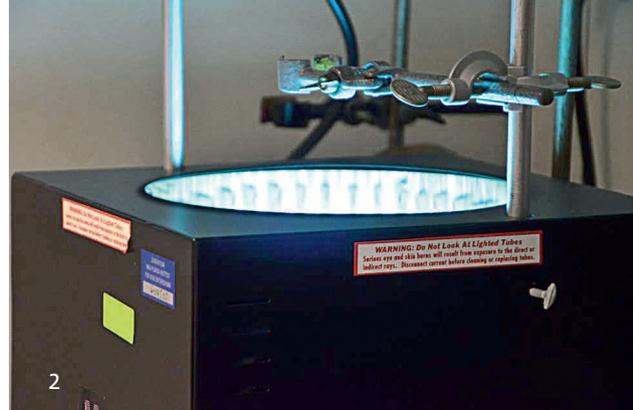
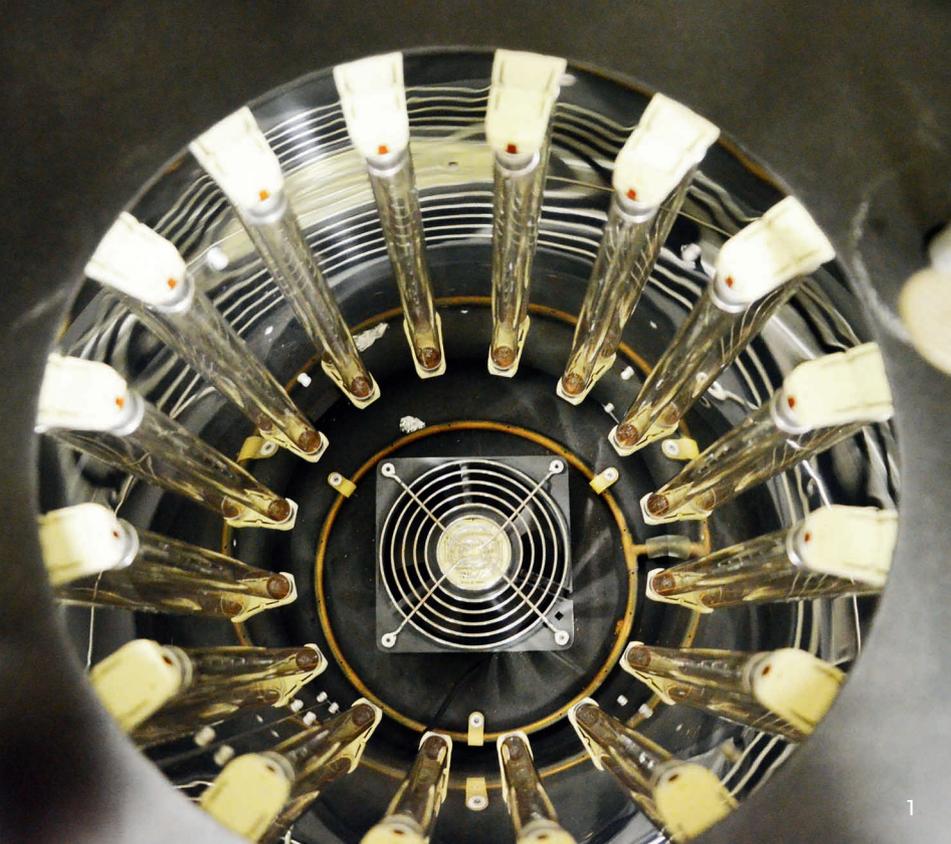
**N**uno Maulide closes his eyes. For a brief moment, there is complete silence in the foyer of the Max Planck Institut für Kohlenforschung. The crowd looks with anticipation at the man who has just sat down at the shiny Bechstein grand piano. The pianist lets the corners of his mouth relax and leans his upper body slightly forward. Scientists and administrative staff, trainees and doctoral students – they all await the moment the pianist will begin his performance. Then he plays the first chord, Frédéric Chopin, and the intoxicating music of the Romantic composer fills the room. The foyer of the institute has been transformed into a concert hall.

For Maulide, the concert is already his second presentation of the day. Earlier, the young researcher from Portugal presented his research work at the institute in Mülheim, for which he

received the Early Excellence in Science Award sponsored by the Bayer corporation. In its introductory laudation speech, the management board of the Bayer Science & Education Foundation called him a “rising star in chemistry.” Now Maulide is playing some of his favorite pieces from the Baroque and Romantic periods for the more than one hundred guests of the award ceremony, on a grand piano rented for the occasion. Piano music and chemistry – these are the passions of the 33-year-old, even if he dedicates decidedly more time to chemistry, not least because he leads a research group at the Max Planck Institut für Kohlenforschung.

It has been a short and steep rise up the scientific career ladder for Nuno Maulide so far. After completing a master’s and a doctoral degree under István E. Markó at the University of Louvain in Belgium, he spent a year in postdoc-

The chemist’s other passion: Before Nuno Maulide began his scientific career, he studied piano.



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toral research with Barry Trost at Stanford University in the US. Trost is one of the fifty most-cited chemists in the world. Afterward, Maulide took up a position as group leader at the Max Planck Institute in Mülheim. Numerous distinctions underscore his success, such as the Bayer Early Excellence in Science Award and the Heinz Maier-Leibnitz Prize of the German Research Foundation (DFG) for 2013.

Maulide received the prize from the Bayer Science & Education Foundation primarily for one of his most successful projects, the selective synthesis of functionalized cyclobutenes. These are square, four-membered ring carbon

compounds that are often structural elements of biologically active, naturally occurring substances – pheromones, for instance. Cyclobutenes are therefore important structural elements in the chemical synthesis toolkit.

With the help of palladium catalysts, Maulide and his team have been successful in harnessing the highly unstable precursors necessary for preparing cyclobutenes. "I'm interested in the fundamental understanding behind chemical reactions. How does the reaction proceed – and why?" explains Maulide. "As a result, my team and I are always bumping into interesting problems – and sometimes we

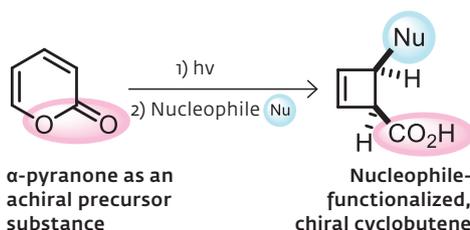
are even able to contribute a new method for synthesizing a naturally occurring substance."

### STUDYING PIANO WAS A SOLITARY AFFAIR

Maulide originally had completely different plans. "I was sure for a long time that I wanted to become a musician," he says. He began playing at the age of nine and later studied at a renowned music conservatory in Lisbon. "Nevertheless, my parents weren't exactly pleased when I revealed my plans to become a professional musician." His parents didn't like the thought that their youngest son might have difficulties finding a permanent job as a musician.

Maulide's father and mother both hail from Africa. He comes from Mozambique, she from the island of São Tomé, both former Portuguese colonies. His parents met as medical students at the University of Coimbra. "Both of my older siblings did something sensible professionally – and then I come along and want to be a musician!"

Maulide found a way to create three-dimensional cyclobutenes from  $\alpha$ -pyranone, a flat precursor substance, using light (hv) and reagents called nucleophiles (Nu). Since these compounds exhibit special three-dimensional structures referred to as chiral, and can be provided with various chemical functions by the nucleophiles, they are ideally suited as raw materials for the preparation of biologically active substances.



left-hand page: Chemists suspend reaction vessels in a device that generates strong UV light (1, 2). The UV radiation sets in motion a chemical transformation, such as a reaction that results in a cyclobutene product. The researchers dissolve each of the products in the most suitable of the many possible solvents (3) in order to analyze them in a gas chromatograph.

right: Nuno Maulide holds discussions with his colleagues in the lab as often as possible, here with Saad Shaaban (center) and Desislava Petkova.



In the end, Maulide enrolled in music studies at the University of Lisbon. “And my parents supported me every step of the way.” He continually gave piano instruction during his studies. Teaching, also part of the everyday activities of a group leader in the Max Planck Society, was already close to his heart. “But I soon noticed that studying piano is a solitary activity – it’s just you and the instrument,” he says today. He took up studies in chemistry after a year – and found in organic chemistry a subject for which he developed just as great a passion as he has for music. “There’s no point doing something if you can’t do it with passion.”

For that reason, Maulide pursues only those chemistry topics that really interest him – but there are many of those. Besides cyclobutenes, he is currently working with sulfur compounds and with lactones. One of the ways a lactone is formed is when a molecule includes both a carboxy group – the characteristic of an organic acid, such as acetic acid – and a hydroxyl group – the characteristic structural unit of an alcohol – and these two chemical groups bond together to form a lactone linkage.

Nuno Maulide’s research group succeeded in developing a new synthetic procedure to prepare lactones, thus facilitating the manufacture of certain or-

ganic substances that chemists simply couldn’t prepare before. In the future, these substances could play an important role in the manufacture of aromas and scents.

Looking back, he says that none of his projects have run as originally planned. Nevertheless, success came quickly. And Maulide’s research interests are far from exhausted by cyclobutenes, sulfur compounds and lactones. “I have a lot of new ideas. And none of them have anything to do with the projects we are working on at the moment,” he says, laughing.

### MAULIDE CONVEYS A PASSION FOR SCIENCE

A few days after the award ceremony, Nuno Maulide enters a small hall in the older building of the institute in Mülheim. Most of the analytical departments work in this building, and it is where the doctoral students and trainees are taught. It has the smell of blackboard erasers and classrooms. It is early morning, yet Maulide shows no trace of sleepiness. There are already 15 junior scientists in the room waiting for their boss.

It’s time for the weekly group seminar. Time for the research team to share and discuss the latest results on their projects, as well as everything else going

on inside and outside the group. This time, Maulide has a stack of copies of the Max Planck Journal with him. “There’s someone in here you might know,” he says, waving one of the copies in the air, and laughs. One of his doctoral students wrote a book review for the current edition. He wants the others to see it. “For me, the atmosphere and cohesion of my group are incredibly important,” stresses Maulide, who describes himself as a very social person.

This camaraderie, the teamwork and the joy of teaching are also some of the reasons that brought Maulide to chemistry. He especially wants to convey to his students a passion for science, and for his field of organic synthesis. It doesn’t matter whether that happens in informal group seminars at the institute or in a lecture at one of the neighboring universities. Whether in the seminar or the lecture hall, his complete attention is dedicated to his students and junior scientists. He listens to them, taking notes. He jumps from his seat now and then and writes something to think about on the board, often only fragments of molecules. He gives praise and encourages the students to acknowledge and accept one another. “Teaching and instruction have always given me a lot of pleasure,” says Maulide. “And it is also what I particularly like about working as a group leader.” >



However, becoming accustomed to the position of being a group leader wasn't so easy at the beginning. "No one knew me and I had no staff." A small team quickly became established, though. "Still, I first had to learn that my decisions could influence the scientific careers of other people now and that I carry a lot of responsibility for my students," says the researcher. "You suddenly grow up and realize that young people are entrusting you with their professional futures. I'm the youngest in my family in Portugal, the little brother. Here I feel like the older brother of my students."

When recruiting new "family members" to the research group, one thing is especially important to Maulide: interpersonal relations. "Only people I like to spend time with work in our team," he emphasizes. "Because it means a lot to me that we can trust each other and are loyal to one another." Consequently, before he hires a new doctoral or postdoctoral student, every candidate is also introduced to the other students in the group – "the kids," as he calls them.

The student-teacher relationship is equally important to Maulide when he is the student, such as when Christel drops by one afternoon. Christel is his German teacher. "Christel came to visit once, and she seemed the ideal person right on the spot," he says, describing his first meeting with the professional translator from the Ruhr area.

A pleasant, concentrated working atmosphere prevails in Maulide's simply furnished office where the German les-

Nuno Maulide has already taken home a number of scientific awards for his research; however, the atmosphere and cohesion of his research group are also very important aspects of his work for him.

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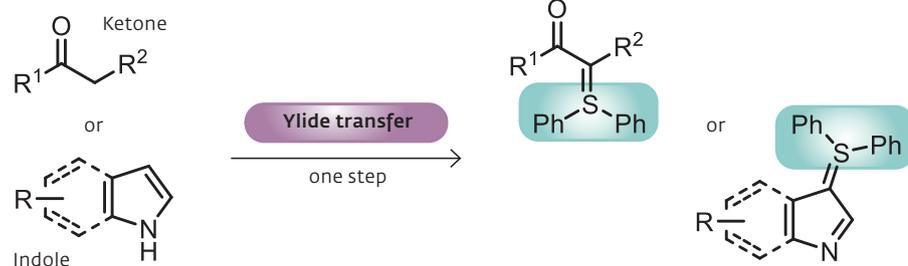
son takes place, just like in the seminars. Nuno Maulide, who has just described a complex synthesis process to his students as a university lecturer, suddenly slips into the role of student. Today's language lesson is all about finance.

### STARTING A NEW CHAPTER IN LIFE IS PAINFUL

With enthusiasm that can hardly be contained, the researcher soaks up the vocabulary on his notepad, even conscientiously learning frightful German compound nouns like *Lastschriftverfahren* (direct debit procedure) and *Einzugsermächtigung* (direct debit authorization). As he ponders a declension, he plants his elbows on the desk and buries his face in his hands – only to rise up again smiling as the answer comes to him.

"If I want to work with German students, I need to be able to speak German well," says Maulide. "That is also important for my students' knowledge of chemistry," he explains later. He sees the biggest difference between his previous stations in life and his current job in the teaching activities and staff responsibility as leader of a research group.

Maulide's team is able to attach ylides, compounds containing a formally negatively charged carbon atom and a positively charged hetero atom, such as sulfur (S), to another molecule, such as a ketone (above) or an indole (below), in only a single step. Previously, the process involved at least three steps.



A conference in Bordeaux proved to be a decisive moment in his scientific career. "I met Benjamin List for the first time there," explains Nuno Maulide. Benjamin List is Managing Director at the Max Planck Institut für Kohlenforschung.

He smiles broadly as he describes this encounter, as he often does when he speaks of things that give him joy and that he recalls fondly. "I had put up a poster about my research project from Louvain. No one seemed especially interested in it." But then Benjamin List happened by. "I was curious what he would say about my project. So I simply called out: May I introduce you to my poster?" Ben List stopped – and the two researchers began to talk. "We almost missed the next lecture."

That was in 2005. Four years later, Nuno Maulide began work as a Max Planck research group leader in Benjamin List's Department of Homogeneous Catalysis. Having just gone to North America a year before, yet another move lay before him. "Of course it's painful when you start a new chapter in your life. You give up the comfort of familiar habits you've acquired. But it's the only way to personal growth," says Maulide – and adds with emphasis:

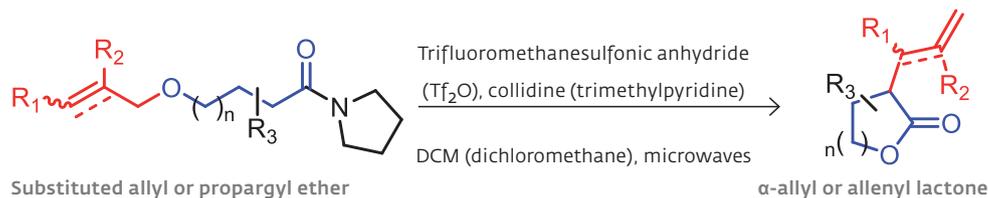
"and at the moment, I can't yet imagine a life in which I no longer continuously seek to grow."

Maulide is young, ambitious and has already been around the world quite a bit as a scientist. "My home will always be my parents' apartment in Portugal, though, just across from the Sporting Lisbon football stadium," he says. However, he also feels at home in his apartment in tranquil Mülheim an der Ruhr. The other stopovers – Switzerland, North America and Belgium – have likewise left traces in his life, be it the impressions and methods he took with him from the various laboratories, or things like fine Belgian chocolates that he brought back with him from European visits for his colleagues in North America. Some boxes of fine Belgian chocolate seashells can still occasionally be found under his coffee table at home.

### EUREKA MOMENT IN THE LIBRARY

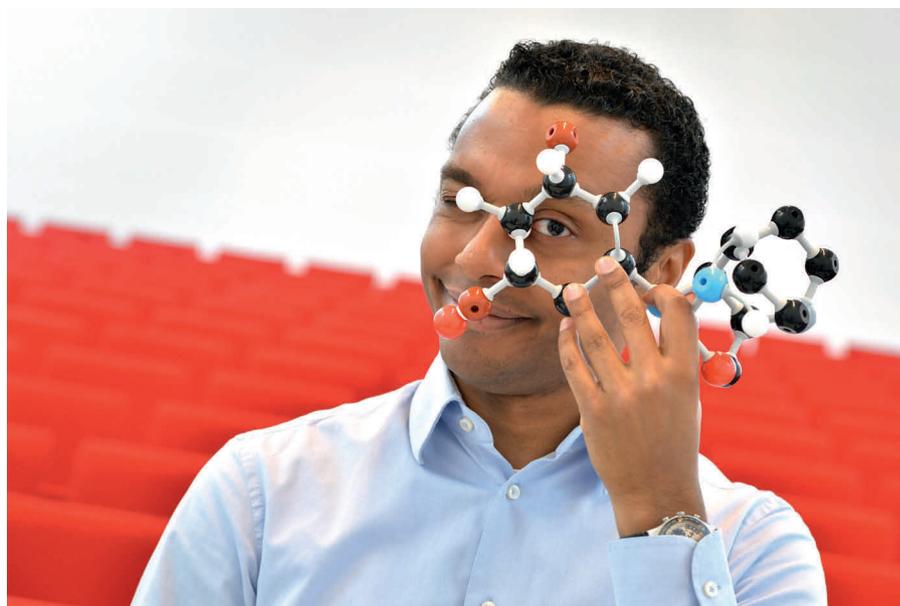
Maulide's research is also characterized by always exploring new territory. His work with cyclobutenes certainly resonated throughout the chemical community, though only a few chemists were involved with these compounds back then. "I'm not someone who likes to look around in the same places where everyone else is busy. I prefer to go my own way."

How did the idea for this project come to him? By browsing the old scientific journals in the library at Stanford. "I love libraries!" exclaims Maulide. "When I have time, I like to look at old journals and the older research work of colleagues." So it was in 2008 at Stanford, as well. He was comparing older scientific articles with the work



Maulide modified a known reaction to make lactones (ester rings) in the solvent dichloromethane (DCM) employing collidine (trimethylpyridine) and trifluoromethanesulfonic anhydride ( $\text{Tf}_2\text{O}$ ) under microwave irradiation.

An allyl or allenyl substituent sits at the  $\alpha$ -position, directly adjacent to the double-bonded oxygen (O) that is characteristic of a lactone. The compound formed can have various groups ( $\text{R}_1$  to  $\text{R}_3$ ) attached. Nuno Maulide is searching for these and other types of new reactions, which can also lead to new molecules. The molecular model he is peering through here may be such a candidate, because it doesn't exist yet.



his advisor Barry Trost was pursuing at that time. Suddenly the idea of applying a step from Trost's research to the synthesis of cyclobutenes came to him. "That was a kind of eureka moment for me."

That's how he became interested in a special class of lactones. "Those are molecules that people worked with in the 1960s and 1970s." At that time, however, all you could produce from lactones were compounds that already decomposed after just a few moments. "After that, no one had any further interest, at least for a while. We discovered that this lactone is cleverer than anyone thought!"

### PIANO PLAYING MELTS AWAY THE CARES OF THE DAY

Although his research and position as group leader take up a great deal of his time and energy, he is also re-dedicating himself to piano playing in Mül-

heim. "For years, the only time I got to play was when I happened by a piano store. I didn't have an instrument at home in Belgium or North America, so I couldn't practice regularly." That changed when he joined the Max Planck Institute in Mülheim. "I had barely moved into my new flat in Mülheim when I rented a piano."

Almost every lunch hour (and many other times as well), Maulide spends time at the piano learning new pieces. "My first great hurdle after I had begun again was the Barcarolle by Frédéric Chopin," he recounts. "Once I had managed that, I knew I could do anything!" And although he's a chemist through and through, the piano is more than a mere hobby for him. He is as ambitious with it as he is in the lab during the day, giving benefit concerts for UNICEF and taking part in international competitions for amateur pianists. Last year, he made it to the final

round of the prestigious Manchester and Paris international competitions.

"When I sit at the piano, all my cares melt away," says Nuno Maulide. "I'm alone with the music and the composers whose work I play." When he gives a concert, he always reveals something of himself, "and much more than during a lecture." But he would no longer want to trade. "As leader of a research group, I can do exactly what I want and what interests me. I have a lot of freedom and I decide in which direction our next projects go. It's always important to me that we're able to analyze everything exactly, especially if the results are unexpected or surprising," he says and emphasizes, "I would also like my students to develop an understanding of the sort of chemistry we are pursuing here!" And he likes to quote a relevant saying attributed to French chemist Louis Pasteur: "Chance favors the prepared mind." ◀

# DAS GELBE VOM EI

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