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# Simply refuel using the Sun – solar researcher Martina Neises

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Martina Neises: She does not want her doctoral dissertation to disappear into a drawer.

By Dorothee Bürkle

One day, we will be able to refuel with solar energy – that is the vision of Martina Neises; and that is what she is working on. As a postgraduate student working towards a doctorate in solar research at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) in Cologne, she is researching a process that uses solar energy to produce hydrogen. The first steps along this path have already been successfully taken by DLR scientists together with partners from other research facilities and industry. Martina Neises simply wants to improve the process.

## Many offers – sights set high

At the end of her mechanical engineering degree at RWTH Aachen University, Martina Neises received several offers with regard to her degree dissertation – and she set her sights very high: "I wanted to work on something that would positively change our future lives." When, in a lecture about solar concentrating technology, she learned about the research areas at DLR, she knew immediately that was the field in which she wanted to conduct research. After her degree dissertation at the DLR Institute of Technical Thermodynamics in Cologne, she started on her doctoral dissertation on solar hydrogen production.

"I was always good at maths and physics," Martina Neises recalls. Puzzling things out, trying things and lending a hand was something she was familiar with from a childhood spent on her parents' farm. Today Martina Neises is experimenting with things in the laboratory of a major research facility. Her task: she wants to optimise the reactor that produces hydrogen by means of solar energy. A pilot reactor was constructed in 2008 at the Plataforma Solar de Almería in Spain. That was when researchers succeeded for the first time in producing hydrogen in a plant on the 100-kilowatt scale by using concentrated solar energy. On the same principle as the Plataforma Solar de Almería – if on a somewhat smaller scale – the mechanical engineer built the Hydrosol plant in Cologne.

Research at the Plataforma Solar in Almería

Martina Neises is a calm young woman, decisive and alert. With a practiced movement she pushes the large glass screen in front of the test rig up and places a circular, two-and-a-half-centimetre ceramic honeycomb structure at the centre of her small reactor. This cylinder, coated with iron oxide, forms the heart of the reactor with which the DLR researchers are producing hydrogen directly using solar energy. In a first step, the reactor heats the coated honeycomb structure of the reactor to 1,200 degrees centigrade. At these temperatures, the iron oxide coating of the honeycomb is chemically reduced; a part of the oxygen is released and transported out of the reactor.

In a second step, the step when the water is actually split, which takes place at 800 to 1,000 degrees centigrade, the researcher pumps steam through the cylinder honeycombs. Now, the reduced iron oxide reacts with the steam. The steam splits; the oxygen is bound in the metal oxide and remains in the oxide coating of the ceramic honeycombs, while the hydrogen flows out of the reactor. Once the iron oxide coating has been completely oxidised, it is regenerated and the cycle starts again from the beginning. Martina Neises' research reactor in Cologne does not use solar energy, but works with artificially generated sunlight. This means that the researcher is not dependent on good weather for doing her measurements and, at the same time, always has exactly the same conditions for conducting her experiments. "That is the only way that I can compare my results," the scientist says.

Martina Neises: Test reactor splits hydrogen and oxygen

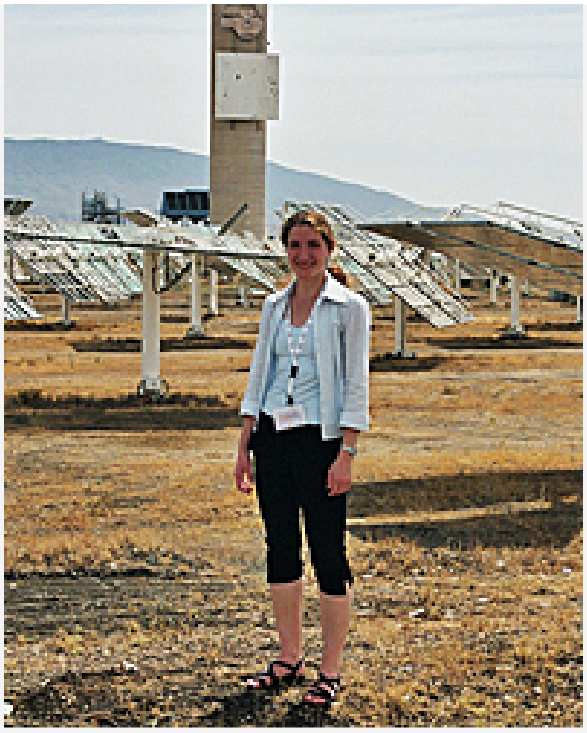
**"You have to develop your own ideas"**

The task of the researcher for her doctoral dissertation is to improve this process further. What does the iron oxide coating have to be like and what must the conditions in the reactor be to produce the maximum amount of hydrogen without the material being exhausted too quickly? The 29-year-old works out the methods to find the answers by herself. "At first glance it is not that simple, since at the beginning you are a newcomer in the field. You have to develop your own ideas. But in this way you can, in the end, have full confidence in your results," Martina Neises reflects on her approach. Her colleagues in the Solar Research Department supported her. She was also able to make use of expertise from other DLR research areas. Researchers from the Institute of Materials Research, for example, helped her to investigate the coated honeycomb structure.

**"We have only just started to work on the processes"**

Martina Neises knows that her research results will not end up in a drawer but will contribute to enhancing the performance of future plants. In industry, the mechanical engineer could be earning

good money following her studies, but she currently has other plans. "It is my personal decision to work in research. It is simply an inner urge to understand how things work and to dig deep. That is probably what unites all researchers."



"The sun still offers many opportunities"

Maybe not tomorrow or the day after, but in the long term, hydrogen can play an important role in our energy mix. Above all with regard to future mobility, many experts see potential in hydrogen to be the fuel of the future – but only once it can be produced without carbon dioxide emissions; that is, using renewable energy sources and non-carbon raw materials. "By producing hydrogen in a chemical process driven by the Sun, we do nothing but store the Sun's energy. Perhaps one day I will be able to fill my car with hydrogen and thus drive with solar energy."

Martina Neises also knows about the many obstacles that still have to be overcome on the long path to her destination. How can the hydrogen be transported from the Sun Belt of the Earth to our latitudes? She takes a positive view: "We have only just started to work on the processes. There is plenty of development potential."

### Sunny job prospects

Once the scientist has concluded her doctoral dissertation, she could well imagine going abroad for a while. "Not because I don't like it here, but because I'm curious," she says. She already has a network of foreign researchers. Once a year she meets researchers and doctoral students from the whole of Europe at the SOLLAB colloquium (Alliance of European Laboratories for Research and Technology on Solar Concentrating Systems). Some of those contacts have, in the meantime, turned into friendships.

Asked about job prospects, she shrugs her shoulders and smiles: "The increasing construction of solar-thermal power plants in the whole world and the developments of recent years confirm that solar concentrating systems will play a major role in the energy supplies of the future. And we have nowhere near reached the end of the opportunities offered by the Sun. Seen in this light, my and our prospects are improving all the time."

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