**Press Release**

Materials Science & Technology

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**Energy: too valuable to waste**

# Synthetic natural gas from excess electricity

**"Power to gas" is a key concept when it comes to storing alternative energy. This process converts short-term excess electricity from photovoltaic systems and wind turbines into hydrogen. Combined with the greenhouse gas $CO_2$, renewable hydrogen can be used to produce methane, which can be stored and distributed in the natural gas network. Empa researchers have now succeeded in further optimising this process.**

The methanation process uses $CO_2$, for example from biogas production, and this combined with hydrogen ($H_2$) from excess renewable electricity, produces methane, which can not only be distributed simply and cost-effectively in the natural gas network, but can also be stored for longer periods of time. This means renewable energy is being used to produce a "quasi-fossil" fuel – the basic principle of "power to gas".

The Sabatier reaction, which produces combustible methane from hydrogen and $CO_2$, has been known for a long time. Now researchers in the Empa "Hydrogen and Energy" Department have succeeded in greatly optimising the process. A catalyst is required to bring about the reaction of $CO_2$ with hydrogen using as little energy as possible; this catalyst can, for example, be made of nickel. The gas molecules react more easily with each other on the surface of such a catalyst, reducing the energy required for the reaction to take place. This is referred to as sorption catalysis. Empa researcher, Andreas Borgschulte, and his team have now combined a nanoscale nickel catalyst with a zeolite. Zeolites are crystalline aluminosilicates with the ability to absorb water molecules and release them again when heated.

The principle is simple: the chemical reaction of hydrogen with $CO_2$ produces not only methane ($CH_4$), but also water ($H_2O$). The researchers use the hygroscopic (i.e. water-binding) property of the zeolite to remove the resulting water from the reaction mixture. The chemical equilibrium then moves towards methane. Result: a higher yield of pure methane and a more efficient catalytic process. As soon as the zeolite is saturated with water, it can be "unloaded" again by heating and evaporation of the water, and is then re-used.

**Project partners sought**

The process works – though currently only in the laboratory. According to Borgschulte, there is still a long way to go before it is ready for commercial exploitation in large plants. Empa researchers are currently looking for project partners in order to build a methanation plant on a larger scale and use it as a pilot project. At the same time, Borgschulte's team would like to optimise the process even further. The next stage is to use four or more sorption catalysts at the same time. When one is saturated with water, the system automatically jumps to the next "dry" catalyst while the previous one is being "unloaded" again.

One problem with this cyclical method up to now has been sulphur, which is produced in biogas plants together with methane and $CO_2$. Sulphur compounds can cause irreparable damage to the zeolite. The researchers are now working on removing the sulphur from crude biogas so that the zeolite continues to work for as long as possible.

In future, Borgschulte also thinks it is conceivable that new catalyst materials that are more efficient than nickel may be used in combination with the zeolite. These could improve the Sabatier process even further. This would mean that excess renewable electricity was no longer wasted but used as the basis for producing sustainable natural gas.

**Further information**

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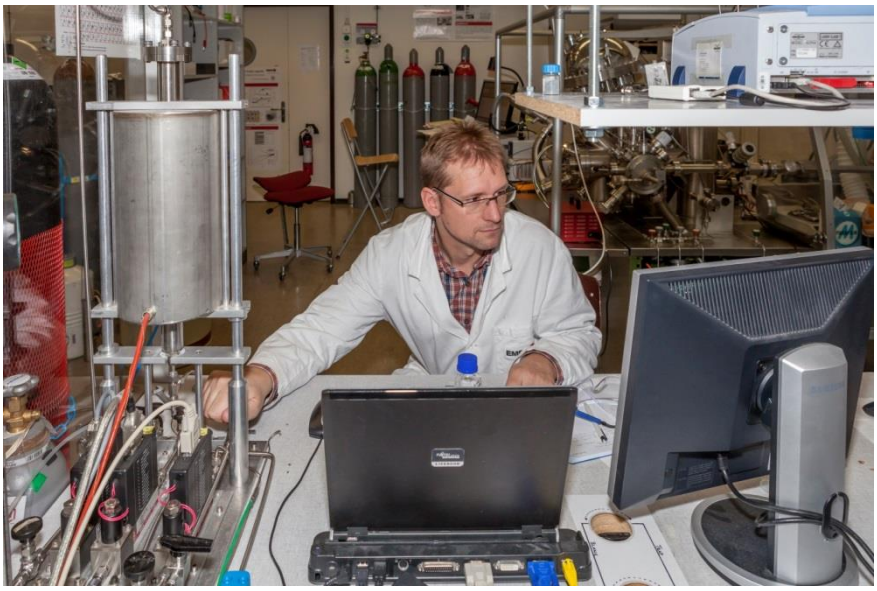
Zeolites bind the water produced during methanation of hydrogen, thereby increasing the methane yield from the new process.



Andreas Borgschulte analyses the chemical processes taking place in the prototype methanation reactor (on the left of the picture).

The pictures can be downloaded from http://flic.kr/s/aHsjPfxJg4