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High-temperature Co-electrolysis – A Key Step for CO_2 Emission Mitigation in Industrial Processes

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Abstract

The mitigation of CO_2 emissions is a major challenge for modern society and especially the major industrial emitters. In order to reduce CO_2 emissions, two basic routes are available: carbon direct avoidance (CDA) and carbon capture and utilization (CCU). Both concepts are favorable for different industrial applications. However, even though there are fundamental differences in these two approaches, they both have in common that electrolysis may play an important role in the technical implementation.

For the steel sector for instance hydrogen has been discussed as a sustainable alternative reducing agent for the production of iron in order to replace fossil fuels, such as coke, coal or methane. A possibility to do so is incorporating CDA concepts into the steelmaking process. One approach in that direction including a solid oxide electrolysis is presented. The concept is expected to allow for a considerable decrease of CO_2 emissions in steelmaking. The process also offers the potential to adapt the electricity demand to the availability of renewable energy while ensuring a constantly high product quality at varying feed gas compositions.

In other industrial sectors CO_2 is an intrinsic part of the process and therefore the formation of CO_2 cannot be avoided. In these cases CCU can be used to mitigate emissions. An exemplary process—the production of lime—will be used in order to demonstrate the advantages of a deep integration of a Power-to-X process. This does not only allow for the utilization of CO_2, but also offers the potential to adjust the electricity demand of the electrolysis in correspondence to the availability of renewable energy without changing the operating point of the synthesis step of the process. A corresponding approach will be presented and discussed. Also a laboratory-scale plant that is to be scaled up in cooperation with an industrial partner will be introduced.