SUstainaBLe Innovative MEmbrane reactor for aviation fuel production

Publieke samenvatting / Public summary

Aanleiding

The aviation sector is faced with a radical transition from fossil fuels to a more sustainable based system. On the initiative of Dutch ministry for Infrastructure and Water Management a worldwide premiere was announced on February 8th this year: “first passenger flight performed by KLM with sustainable synthetic kerosene”. For this premiere, Shell Amsterdam produced 500 liter of kerosene from CO2, water and renewable electricity with its pilot Fischer Tropsch Synthesis (FTS) facility. Shell has vast experience with FTS, which is well developed and available at large scale, but normally the syngas feedstock is produced from fossil fuel gasses. Alternatively, production of syngas from CO2 is subject for improvement. Based on an extensive evaluation done by Shell and TNO, TNO's SIENNA technology was selected as a promising technology for the conversion of CO2 to syngas. In this SUBLIME proposal, the SIENNA Versie tender TSE Industrie 2021 – met uitzondering van Circulaire economie 2 lab-scale skid will be used for proof-of-concept production of syngas. The partnership is an experienced and highly motivated consortium to contribute to the cost effective production of SAF.

Doelstelling

The project aims to advance the technology level of an innovative membrane reactor SIENNA as part of a technology chain producing CO2-based (aviation) fuels. In the reverse water gas shift reaction (RWGS), CO2 and H2 are converted to a syngas product, in preparation for a successive Fischer

Projectinformatie / Project information

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Algemene informatie / General information

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Tropsch step towards Sustainable Aviation Fuel (SAF). Here, the RWGS reaction is limited by chemical equilibrium, especially at lower temperatures. Therefore, this project focuses on development of novel membrane reactor technology SIENNA for pushing the RWGS step beyond this limitation. The SIENNA reactor contains a membrane and cooling element, which allows it to remove the water by-product in an innovative manner and to push the gas composition to a more desirable syngas composition. The technical aim is to have a high conversion (>20% above the standard RWGS equilibrium value) towards the CO product at lower temperatures (250-350°C). Overall the technological developments proposed in this project enhance the performance of the technology chain, starting from CO2 and H2, to production of cost-effective sustainable aviation fuel.

Korte omschrijving

The consortium is in a unique position to advance the technology level of an innovative membrane reactor, as part of the technology chain from CO2 and H2 to aviation fuel. The activities are organized in five work packages: WP1 – Use case definition (Shell, TNO) WP2 – Proof-of-concept SIENNA reactor for RWGS (TNO, Shell) WP3 – Reactor development (TNO, Shell) WP4 – Membrane selection (CoorsTek, TNO, Shell) WP5 – Techno-economic evaluation integrated process CO2 to jet fuel and gap analysis (Bilfinger Tebodin, Shell, TNO)

Resultaat

Within the project the following technical results will be achieved. Firstly, a proof-of-concept (WP2) will be achieved for the reverse water gas shift reaction in the SIENNA reactor with in-situ water removal for achieving an optimal syngas composition. Secondly, the potential of the innovative SIENNA reactor is further explored by conceptual reactor modelling and reactor optimization (WP3). In addition, a fit-for purpose membrane from CoorsTek will be developed to aid experimental proof-of-concept activities in WP2. Thirdly, the future potential of the technology is evaluated in a techno- economic evaluation (WP5). In addition, results after

completion of the project include: - Increase of technology readiness of the improved technology chain from CO2 and H2 to a sustainable aviation fuel. - Providing an innovative synthetic aviation fuel production route starting from CO2 and H2 with unique advantages due to novel reactor technology.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.
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