

Plasmasynthese van stikstofhoudende halffabricaten voor duurzame landbouw en circulaire kunststoffen

Publieke samenvatting / Public summary

Aanleiding

Nitrogen (N) containing molecules are essential for production of fertilisers and fine chemicals such as engineering plastics and pharmaceuticals. Their industrial synthesis involves hydrogen production by steam reforming of natural gas, followed by ammonia production via the Haber-Bosch process. At Chemelot, ammonia synthesis causes 35% of the GHG emissions at 2.2 MtCO₂eq/year. At Sluiskil it is responsible for 3.4 MtCO₂eq/year. Dutch and European climate ambitions set the urgency for sustainable alternative processes. The recent events in Ukraine add urgency from the perspective of continuity in global fertilizer production & food supply and independence of the national process industry on (pricing of) raw materials. Both Russia and Ukraine are important producers of fertilizers and Dutch/European N-chemistry relies heavily on imports of natural gas from Russia.

Doelstelling

This MOOI sustainable nitrogen chemistry project aims to circumvent energy intensive ammonia production by activation of nitrogen molecules with sustainable electricity in electrical discharges (plasma). It enables synthesis of alternative, more economical, chemical building blocks such as NO and HCN. The approach achieves circularity, as no fossil inputs are required. As far as carbon is required, it uniquely valorises CO₂ (from air or biomass) and/or CH₄ (as primary output from

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Algemene informatie / General information

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Publicaties en materialen / Publications and attachments

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Voortgangsrapportage 1

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biomass reforming or plastic recycling). In effect, process technology is developed that offers (i) reduction of overall energy consumption, (ii) zero GHG emissions, (iii) compatibility with intermittent sustainable electricity, (iv) small scale local production opportunities, and (v) compatibility with circular carbon strategies.

Korte omschrijving

Initially, literature, patent, market, safety and social impact studies will refine the current knowledge basis and maximize efficiency and impact of the R&D project by fine tuning the project plan where necessary. Specific attention will be paid to the dynamics of cost-determining factors such as electrical energy, raw materials, products, installations, CO₂ tax, etc. that eventually determine the investment and operational costs associated with the intended applications.

Subsequently, the available R&D facilities required will be adapted and configured to fit the demands of the project. Both experiments and model studies will be carried out to investigate the primary plasma activation/conversion of nitrogen, subsequent chemical reactions, and possibilities to control them through controlled cooling in order to optimize the desired CO₂-free product formation of nitric oxides and (hydrogen) cyanides.

Resultaat

The proposed project will cover the development phase of plasma activation of nitrogen as alternative to Green Haber-Bosch, which means implementation of the technology in a prototype at lab scale (TRL4) up to implementation relevant conditions (TRL6). The main target is to establish the competitiveness of the technology in comparison to Green Haber Bosch in terms of economics, efficiency, productivity, safety, and acceptability. It will demonstrate the potential to fulfill a role as game changing technology in the transition of the process industry to sustainability and raw materials circularity. The work will prepare for demonstration and/or application on an industrially relevant scale within 10 years from today.

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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