

High Flux 2D Nanosheet membranes

Publieke samenvatting / Public summary

Aanleiding

Many industrial process streams contain water/solvent and other valuable components that need to be separated. The polymeric nanofiltration membranes that are widely nowadays used in effluent and water treatment normally show good permeability and stable rejection. They offer a more sustainable and energy efficient alternative to currently used separation technologies. However, the good and efficient performance of polymeric membranes are often lost when the mixture contains an organic solvent. This due to phenomena like swelling and membrane degradation. As a result of this, the rejection and permeability polymeric membranes becomes frustrated, which hinders the implementation of these membrane technologies in industrial streams. In recent literature, a very promising new class of inorganic membranes, 2D-nanosheet membranes, is described. This class claims breakthrough values for flux and selectivity. Besides, these membrane are also stable in a large variety of industrial streams (e.g. water-solvent mixtures, water, and solvent environment).

Doelstelling

The proposed project aims to demonstrate and validate the high potential of this new class of inorganic high flux 2D Nanosheet membranes on a practical scale. With practical scale it is meant that the production concept can be upscaled via envisioned membrane fabrication techniques. In the literature, it is suggested that these 2D-nanosheet membrane systems might be manufactured with cost and energy efficient methods and that the pore size, size between the nanosheets, can be tuned to

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fit a wide-range of applications. As a result of this it would be possible to produce a family of easily tunable solvent tolerant filtration systems with an exceptional high flux of up to 5000 LMH (TMP=1 bar) and good separation. This device could be employed to purify process streams from components before further processing or to treat effluent prior to discharge or incineration when biological effluent treatment processes cannot handle these streams.

Korte omschrijving

The project will be divided in two parts: Part 1: 1. Proof of principle: to answer the fundamental questions on this high flux 2D nanosheet membrane and to produce and assess the potential of this membranes. Based on the results a go/no-go decision will be made for the rest of this proposal. Part 2: 2. Development of new systems with an MWCO between 200-1000Da. These membranes must have a competitive performance in a wide range of organic solvent and organic solvent-water mixtures. 3. Tuning the affinity of the system for selective removal of one component based on affinity from mixtures (e.g. separate alcohols from hydrocarbons). 4. Long-term stability testing to evaluate the stability of the new filtration systems. 5. Techno-economic evaluation and setting up a roadmap for implementation.

Resultaat

Part 1: The result is to develop proof of principle of this very promising new high-flux affinity separation technology. Part 2: The result of part 2 is to develop a new class of inorganic high flux affinity separation systems that can operate as well in organic solvents, organic solvent/water mixtures, acidic and basic systems. The proof of principle of the developed membranes will be applied to real industrial streams in a laboratory environment (TRL 6). The membranes will reach readiness to enter into future pilot testing on real industrial streams (TRL 7). Lastly a techno-economic analysis and roadmap for implementation in 2 years will be made.

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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