Sustainable synthetic fuels from biomass gasification and electrolysis

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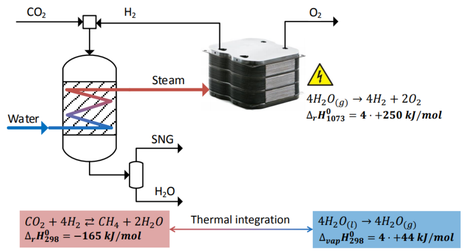
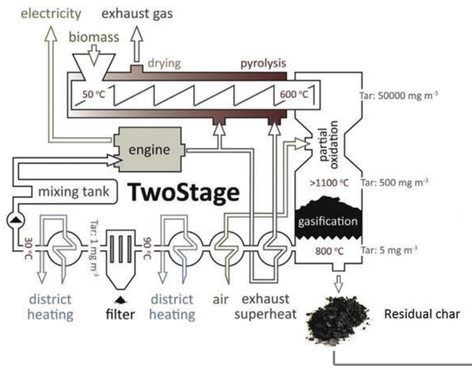
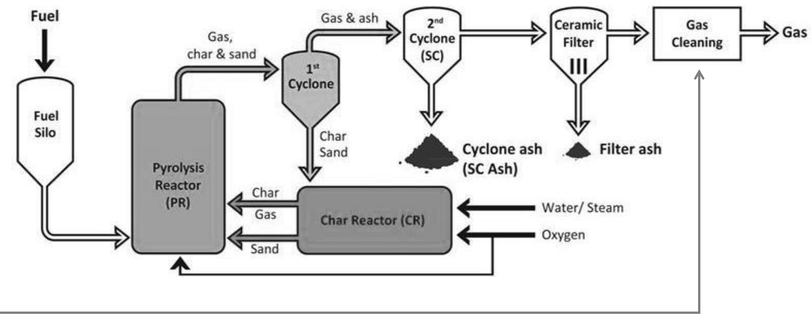
Overview

Denmark has set an ambitious goal of running the entire country on renewables by 2050. This requires overcoming serious challenges and ingenious solutions. Coupling solid oxide electrolysis with biomass gasification is a part of the solution and offers a sustainable way of producing fuels for the transport sector.

Using surplus electricity from, e.g., wind power to produce hydrogen by steam electrolysis and add it to gasified biomass thereby extending the biomass resources. By combining high temperature electrolysis and thermal gasification with a catalytic converter, it becomes possible to synthesize methane or liquid fuels such as methanol. The combined process is very energy efficient due to a tight thermal match between endothermic and exothermic processes.

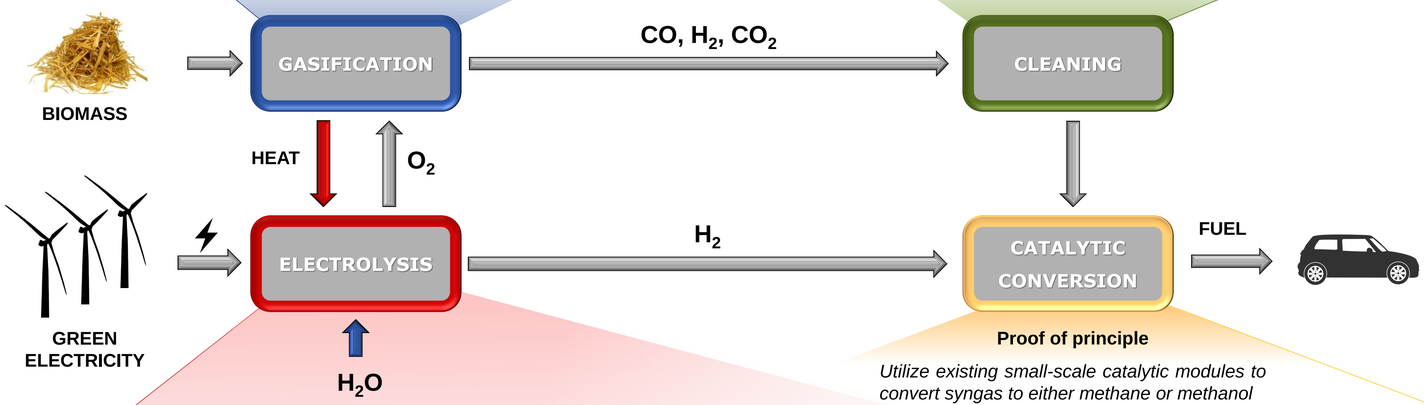






Biomass gasification

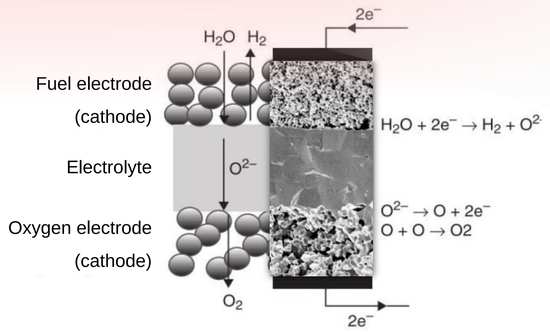
- *Low Temperature-Circulating Fluidized bed (LT-FCB) gasifier*
- *Oxygen blown gasification – more efficient*
- *Efficient, cheap and sustainable gas cleaning;*
- *Characterization of solid residuals;*



Outcome

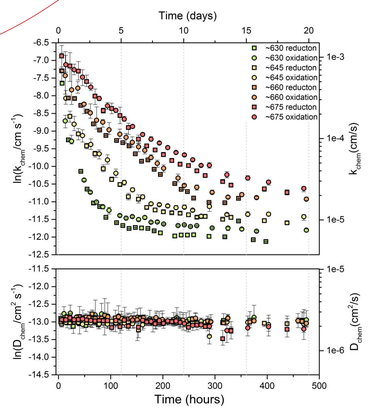
- More durable and mechanically robust electrolysis cells with improved electrochemical performance;
- Proof of feasibility of oxy-firing in an LT-CFB gasifier;
- Novel routes for gas cleaning;
- Identification of the most efficient and cost competitive ways to integrate the processes;
- The development of a solid oxide electrolysis module optimized for operating together with a gasifier;
- Demonstration of the concept at proof-of-principle level by showing fuel production combining electrolysis, a biomass gasifier and a catalytic upgrading process.

Solid oxide electrolysis cell



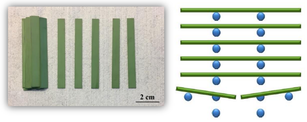
Improvement of oxygen electrode

- *Understand governing mechanisms;*
- *Enhance electrochemical performance;*
- *Make highly efficient Co-free electrodes.*



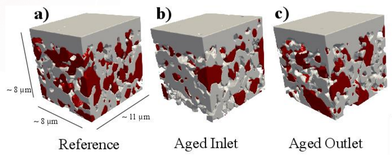
Improvement of mehcanical properties

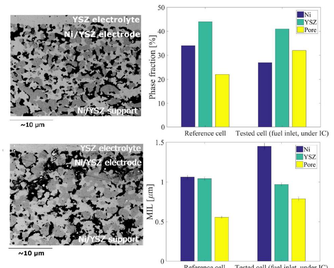
- *Understand toughening mechanisms in YSZ;*
- *Supress fracture processes at high temperature.*



Understanding degradation processes

- *Phase field modeling;*
- *3D microstructural characterization.*





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