LABORATORY FOR CHEMICAL TECHNOLOGY
Technologiepark 125, 9052 Gent, Belgium

Coach	Supervisor(s)	Funding
ir. Sébastien Siradze ir. Klaus Jacobs	prof. dr. ir. Jeroen Lauwaert prof. dr. ir. Joris Thybaut,	-

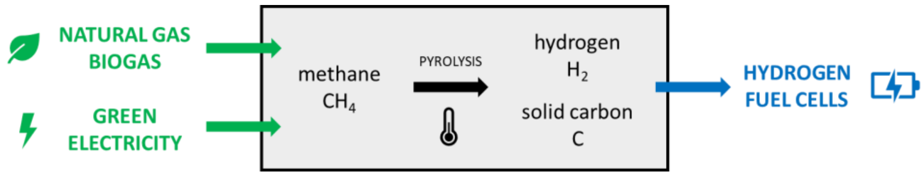
Heat transfer modelling of electrically heated catalytic methane decomposition

Aim

Assess the viability of using electrical heating for catalytic methane decomposition via modelling. The heating in the reactor will be modelled by constructing the necessary heat balance equations and the equations will be implemented into a code for a fluidized-bed reactor model which already includes the kinetics of catalytic methane decomposition. The effects of the reactor configuration, such as the catalyst particle size, on the kinetics will be investigated.

Justification

The use of hydrogen as an energy vector has been gaining a lot of attention, as hydrogen can produce large amounts of heat and electricity electrochemically. Currently, the hydrogen in fuel cells mostly originates from fossil fuels, which makes catalytic methane decomposition a promising reaction, as it can produce hydrogen without CO_2 emissions by converting methane to hydrogen and solid carbon. Possible feedstocks for catalytic methane decomposition include natural gas, which is currently mostly wasted through flaring, and renewable sources such as biogas. Carbon-based materials are promising catalysts for the reaction, as the solid carbon which is formed as a product can itself continue the catalysis of the reaction by making the catalyst particles grow.



Industrially, the heating of reactors is mostly done using an external fire box by burning fossil fuels. As the carbon-based catalyst particles are conductive, an alternative approach is the direct heating of the catalyst particles, which can be done using green electricity from renewable sources. Different possibilities include electrothermal reactors, in which the conductive catalyst particles are heated using an electric flow, and induction heating, in which an alternating magnetic field generates heat in the conductive catalyst particles. The goal of this thesis is to model the heat transfer in a catalytic methane decomposition reactor and assess the feasibility of different heating techniques for the reaction.

Program

1. Literature survey on catalytic methane decomposition and different heating technologies for fluidized bed reactors.
2. Modelling of the heat transfer using different heating techniques by constructing the necessary heat balance equations and implementing them into a reactor model