Production of high quality syngas from biomass using a combined catalyst and non-thermal plasma technology

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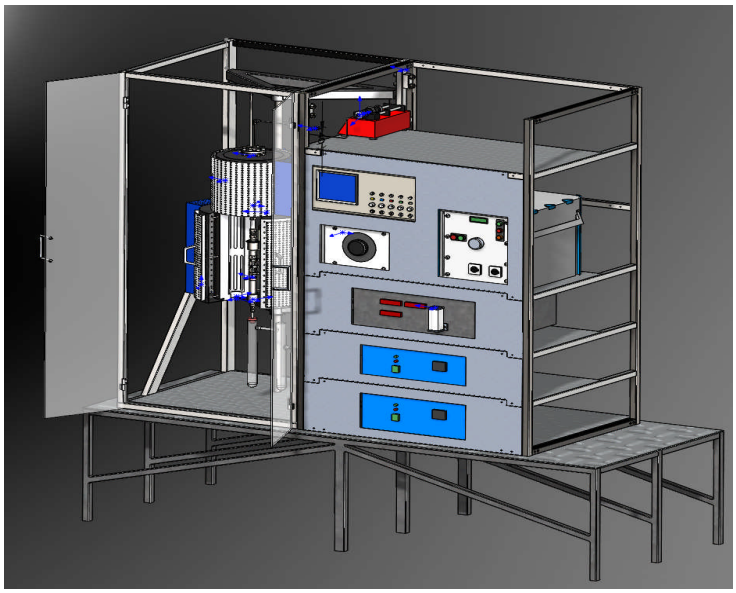
Biomass gasification is considered a promising technology in order to develop a sustainable energy system and to decrease our current dependence on fossil fuels. Thus, biomass is converted into a syngas stream which can be combusted for power and heat generation but also used as raw material for production of fuels and chemicals. The main drawback of biomass gasification and its implementation at large scale is the formation of tar compounds together with the product syngas. The presence of tar makes the syngas problematic for applications such as the Fischer-Tropsch process for chemical production where syngas tar leads to serious coke deposition over the catalyst. The main objective of this study is to develop a low temperature plasma-catalytic process that can be used to produce a high quality syngas from the gasification of biomass.

Wood pellets were used as a feedstock. Pyrolysis plasma-catalytic steam reforming of wood pellets was carried out in a two-stage pyrolysis fixed bed and plasma DBD reactors. The pyrolysis reactor was constructed of stainless steel and was externally electrically heated with furnace with full temperature control and monitoring. Pyrolysis of the wood pellets occurred in the first reactor at 600 °C under nitrogen atmosphere, and the product pyrolysis volatiles were passed directly to the plasma DBD reactor, where plasma-catalytic reactions occurred. The plasma-catalyst reactor was also externally heated to 250 ºC to avoid any condensation over the catalyst bed. Ni based catalysts were prepared by conventional wet preparation method and calcined at 750 ºC for 3 hours. The gaseous product produced from the process was collected by a Tedlar gas sample bag and analyzed by packed column gas chromatography (GC). The amount and nature of the coke deposited over the catalyst were analysed by TPO and SEM. Tar compounds were sampled using solid Phase absorption method (SPA).



Pyrolysis-plasma catalytic steam reforming

The results showed that applying plasma with a catalyst produced the highest syngas yield and the lowest tar yield and carbon deposition over the catalyst compared to using the catalyst or plasma alone.