Decomposition of carbon dioxide in the three-pass flow dielectric barrier discharge plasma reactor

Widiatmini Sih Winanti, author

Abstrak

Carbon dioxide (CO2) as one of the greenhouse gas emissions was decomposed to Carbon Monoxide (CO) and Oxygen (O2) in the three-pass flow Dielectric Barrier Discharge (DBD) plasma reactor, a new designed reactor that having special configuration of its reactant gas flow.
This configuration can simultaneously cools the High Voltage Electrode (HVE) during the reaction process; and preheats the gas feed flow before entering plasma zone as well. This
article explains the result of a preliminary research which aims to observe the performance of this reactor in utilizing CO2, mixed with CH4 to produce synthesis gas CO and H2, in a CO2 reforming process. This research was conducted using 3 (three) different reactor lengths, they were 36, 24 and 12 cm (Re1, Re2 and Re3), to observe the results of CO2 decomposition performance in the difference reactor lengths, and to observed the occurrence of reverse reaction inside the Re1 reactor. Other parameters were feed flow rates and the reactor voltage. Applied CO2 flow rates were 500, 1000 and 1500 SCCM/minute and applied reactor voltage were 5.4; to 9.5 kV. Results show that the conversion of CO2 was increased with the increasing of reactor voltage and longer reactor. The highest conversion was achieve at the lowest feed flow rate 500 SCCM/minute, this mean in the longest residence time. However, CO2 was only reaching the maximum conversion value on the reaction time of 2.1 minute, and dropped off after that. It is possibly caused by occurring of the reversed reaction due to the high temperature plasma reaction. At that point, the Specific Energy (SE) was 270 kJ/mol. This value is lower compare to the previous research results, as well as compare to its energy bonding, that shows the more energy efficient performance of this reactor.