PLASMA CONTROLLED REFORMING PROCESS OF HYDROCARBON FUELS

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Expectation on the hydrogen economy has been drawing diverse applications of hydrogen and synthesis gas. From transport, environmental issues to chemical industries, One of the representative examples is on board reforming of diesel fuel. Synthesis gas from reforming of fuel can be used as reducing agent for NOx reduction process. Also the reformate gas can be supplied to engine during engine start-up resulting in drastic reduction of unburned hydrocarbon emission. In the case of residential fuel cell application, existing infrastructure of city gas can be used to produce hydrogen through reforming process.

Existing reforming process is obtained by reforming catalyst. But demerits of reforming catalyst such as rather low GHSV(Gas Hourly Space Velocity), slow start-up and coking make the use of catalyst difficult. However, compared to the catalytic reforming process, plasma reforming process can host rather fast reaction. Also the process has fast start-up of 'switch-on' working characteristic and insensitive to coking. Though plasma process costs high, there are specific applications such as on board reforming where plasma only meets the requirement of performance. Also process optimization such as plasma-catalyst combined process can make plasma more feasible.

This work reports analysis on the characteristics of plasma reforming of hydrocarbon fuels in both gas (methane) and liquid (diesel) phase. Rotating arc reactor driven by AC power with 10 kHz is used. Controlled plasma state can parameterize reaction process and control the interaction of plasma-chemical process. In plasma induced partial oxidation process, reactant composition and electric power parameterize the process with different path and at different reaction stage. Different relative dominance of each parameter results in different product composition and by product. In overall reaction process, plasma chemistry itself is not a strong factor but plasma works as important controlling factor of thermal process and this is why electric power itself controls differently with reactant composition.

The results can be applied to reforming process of hydrocarbon fuels other than methane and diesel and the analysis on the reaction paths in this work can give theoretical ground work for process optimization.