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ADMISSION TO PHD STUDIES FOR THE YEAR 2021

DOCTORAL RESEARCH TOPIC:

Investigation of non-equilibrium gliding arc plasma application for methanation process

RESEARCH FIELD:

Energetics and Power Engineering (T 006)

BRIEF DESCRIPTION OF RESEARCH TOPIC:

Relevance

Limited fossil fuel reserves, increasing energy consumption and rising concerns about climate change induced a change in the energy landscape, with a shift from fossil fuels to renewable, sustainable energy sources. The development of large-scale energy storage systems is a crucial issue. None of the existing energy storage technologies such as batteries, pumped hydroelectric storage or fly wheels can compete with the energy density of hydrocarbons. Therefore, a significant amount of effort is being directed into research for the production of synthetic fuels.

Scientific issue

Methanation reaction is a highly exothermic and volume contrast reaction, which means pressure and temperature significantly influence the reaction equilibrium. From the thermodynamic point of view, it is desirable to operate the reaction at low temperature to achieve high CO2 conversion. However, low temperature also means slow reaction kinetics and when the temperature is below 250°C, the conversion is negligible. From a technical-economic and wider industrial application point of view, the aim for the process to take place at atmospheric or slightly higher pressure (>5 bar).
Plasma known as a partially ionized state consists of many active species such as electrons, ions and radicals. Non-thermal plasma (NTP) can generate high energetic electrons (1–10 eV), while the bulk temperature can keep as low as room temperature. Among the NTP technologies, the gliding arc discharge (GAD) plasma is characterized by both non-thermal and thermal properties and is promising to be used in catalytic methanation process. The synergy of catalyst with GAD plasma could initiate chemical reactions such as ionization, excitation and dissociation at a lower temperature without affections of methanation reaction kinetics, and may also have an additional effect on the physico-chemical properties of the catalyst.

Objective

To investigate the application of non-thermal gliding arc discharge plasma on the efficiency of the catalytic methanation process.

Goals

- To design a plasma catalytic methanation reactor system and determine optimal operational and process parameters.
- To investigate the efficiency of the plasma-assisted catalytic methanation process and perform a comparative study.
- To investigate the influence of non-thermal plasma on catalyst activity.

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