Greenhouse Gas Treatment and H_2 Production, by Warm Plasma Reforming.

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ABSTRACT

Carbon dioxide (CO_2) and methane (CH_4) have been identified as the most significant greenhouse gas (GHG) arising from anthropogenic activities affecting the climatic global change. It is of great importance to reduce GHG emissions in order to counteract global warming.
This paper considers dry GHG reforming, involving synthesis gas generation followed by the production of some other solid by-products. CO_2 and CH_4 are both relatively stable compounds with low potential energies. The dry reforming reaction is highly endothermic and external energy must to be provided in order to drive it in the forward direction. More recently, applications of plasma gas reforming are highlighted as promising technique for energy saving and environment safe purposes with increasing demand of hydrogen and synthesis gas. In the case of plasma reforming, high energy electron must provide not only radical species, but also enthalpy required for endothermic reaction. The conversion of hydrocarbon in by-products with high added value, is mainly contributed by dissociation and ionization, when a plasma discharge processes is used; therefore, the more energy consumed by these two kinds of reactions, the more energy-effective for hydrocarbon reforming. Although the low pressure plasma, such as radiofrequency or microwave plasma could achieve high hydrocarbon conversion and good H_2 selectivity, the low H_2 production rate and extra energy requirement for vacuum device restrict its practical use, therefore, the plasma reactor here proposed must fulfill two principal characteristics: Environment-friendly and Auto-sustainable. Warm plasma is a transitional discharge which has low specific energy requirement (1-3eV) but still maintaining enough high temperature (2000-3000K) to produce excited species supporting subsequent chemical reactions. Such plasma discharges have significant advantages: Do not require extra cooling systems, since they work with reduced current flows and high voltages, this avoid electrodes erosion and stainless steel walls in the reactor designs can be used.

Keywords: Plasma Reforming, Greenhouse gas, Synthetic gas