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Hydrogen Production Through Thermocatalytic Decomposition of Methane Over Biochar

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Abstract : Catalytic methane decomposition (CMD, reaction 4) is a one-step process for hydrogen production where carbon in the methane molecule is sequestered in the form of stable and higher-value carbon materials. Metallic catalysts and carbon-based catalysts are two major types of catalysts utilized for the CDM process. Although carbon-based catalysts have lower activity compared to metallic ones, they are less expensive and offer high thermal stability and strong resistance to chemical impurities such as sulfur. Also, it would require less costly separation methods as some of the carbon-based catalysts may not have an active metal component in them. Since the regeneration of metallic catalysts requires burning of the C on their surfaces, which emits CO/CO2, in some cases, using carbon-based catalysts would be recommended because regeneration can be completely avoided, and the catalyst can be directly used in other processes. This work focuses on the effect of biochar as a carbon-based catalyst for the conversion of methane into hydrogen and carbon. Biochar produced from the pyrolysis of poplar wood and activated biochar are used as catalysts for this process. In order to observe the impact of carbon-based catalysts on methane conversion, methane cracking in the absence and presence of catalysts for a gas stream with different levels of methane concentration should be performed. The results of these experiments prove conversion of methane in the absence of catalysts at 900 °C is negligible, whereas in the presence of biochar and activated biochar, significant growth has been observed. Comparing the results of the tests related to using char and activated char shows the enhancement obtained in BET surface area of the catalyst through activation leads to more than 10 vol.% methane conversion.

Keywords : hydrogen production, catalytic methane decomposition, biochar, activated biochar, carbon-based catalyts
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