Hydrogen production by fast methane pyrolysis in a ceramic tube

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Methane pyrolysis is one of the possible methods for producing low-carbon hydrogen. To reduce the operating temperature of the methane pyrolysis process and accelerate the process, various non-metallic (mainly carbon-based) and metal catalysts are used. In this paper, the process of pyrolysis of methane on the inner wall of a ceramic tube made of aluminum oxide at a maximum pyrolysis temperature of 1100 C is investigated. Aluminum oxide has been selected as a promising catalyst for the pyrolysis process due to its high operating temperature and its availability. In the experiments, methane passed through a 10-centimeter heated zone of a ceramic tube with an inner diameter of 10 mm. The methane feed rate was about 35 ml/min. The gaseous product of methane pyrolysis was studied by gas chromatography. The purpose of this work was to determine the yield of hydrogen and the composition of the gaseous product depending on the time of gas sampling, as well as conducting a SEM analysis of the soot obtained during pyrolysis. The yield of hydrogen in gas samples decreased over time, and the methane content increased. Two gas samples were examined, the first gas sample was taken at the beginning of the experiment and the second gas sample 2 hours after the start of the experiment. The yield of hydrogen at a pyrolysis temperature of 1100 C in the first and second gas samples was 75.76% and 68.38%, respectively. Further work on the production of hydrogen by pyrolysis of methane in ceramic tubes made of aluminum oxide should be devoted to solving the issue of developing technical solutions for removing carbon from the working area of the reactor, which is deposited and compacted on its walls during pyrolysis. Solving these problems requires technological refinement.