PROCESSES IN METHANE-CONTAINING PLASMA CREATED BY PULSED ELECTRON BEAMS AND NON-SELF-SUSTAINED DISCHARGES

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At the present time methane reprocessing is realized at substantial heating and high pressure of mixture being processed. It produces significant difficulties in the case of the use of electron accelerators. Thus, a search of parameters of electron-beam influence on methane which provide a high efficiency of methane conversion at a room temperature or at inconsiderable heating is an actual problem. Methane conversion at a temperature of 30-40°C has realized during irradiation of alkanes mixture by continuous electron beam at the Institute of Physical Chemistry RAS [1]. We proposed to use pulsed electron beams for irradiation of methane-containing mixtures [2].

A rep-rated electron accelerator with a structure and parameters described in [3] was used in the experiments. A technical methane (~96% of methane, ~1% of oxygen, ~1% of ethylene, 0.8% of acetylene, 0.4% of butane, 0.3% of isobutane; ~0.5% of other components) was inserted into reaction chamber at a room temperature and an atmospheric pressure. The mixture was irradiated by an electron beam with a current density of 0.06 A/cm^2 and a pulse duration of ~40 ns or by a non-self-sustained discharge initiated by an electron beam.

A possibility of methane conversion without a significant heating of a processed mixture has confirmed during the experiments. Main products of the methane conversion in the experiments were ethylene, acetylene, butane, and isobutane. Energy expenditures for conversion of one CH_4 molecule were less than 13 eV with the use of the electron beam.

Experiments with the use of a non-self-sustained discharge initiated by an electron beam have indicated that maximum methane conversion degree was achieved at a voltage of the discharge combustion of 3-7 kV. However, specific energy expenditures in this case were significantly higher than in the case of electron-beam processing of the mixture.

A computer modeling of processes in a plasma of methane-containing mixtures irradiated by the electron beam with the parameters presented above has carried out. A comparison of calculated values of conversion degrees of main components with experimental ones has approved a correctness of the proposed model.

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References

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