Experimental Research of Methane Conversion is Activated By Electron Beam: Measurement with a Molecular-Beam Mass-Spectrometery

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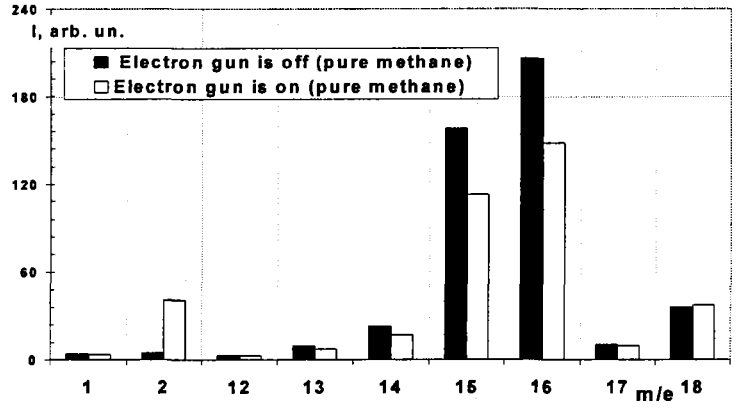
This work is about research conditions of methane conversion to molecular hydrogen. The experimental set-up includes annular nozzle as a gas source, electron gun with plasma cathode that generates electron beam, flow reactor (length = 330 mm, i.d. = 28 mm). Probe is picked as a neutral molecular beam by earthed skimmer (d = 3 mm) from the end of reactor. Then the molecular beam reaches monopole mass-spectrometer where ionization occurs.



Part of pure methane mass spectrum is shown on the figure. Average energy of activating electrons was about 2,5 keV, electron current ~ 200 mA. The conversion ratios K, R were calculated. R shows number of hydrogen molecules produced by one molecule of methane spent,

$$R = \frac{n(H_2) - n_0(H_2)}{n^0(CH_4) - n(CH_4)} = \frac{I(H_2) - I^0(H_2)}{I^0(CH_4) - I(CH_4)} * \frac{\sigma_{CH_4^+}(CH_4)}{\sigma_{H_2^+}(H_2)}$$

$$K = \frac{n(H_2) - n_0(H_2)}{n^0(CH_4)} = \frac{I(H_2) - I^0(H_2)}{I^0(CH_4)} * \frac{\sigma_{CH_4^+}(CH_4)}{\sigma_{H_2^+}(H_2)}$$

where n(i) is the concentration of compound i after activation, $n^0(i)$ – one before activation, I(i) – current of ions i after activation, $I^0(i)$ – one before activation, $\sigma_{i+}(k)$ – partial cross section ionization of *k* molecule for *i*th fragment.

In addition to pure methane we have used $10\%CO_2+90\%CH_4$ mixture. Dependences K and R on the entering energy to the mix are shown in the table. The results provide the possibility to create arrangement of syngas produced by electron-beam plasma conversion.

ε, J/G	1,92	3,53	7,22
K	0,14	0,31	0,58
R	0,28	1,05	1,92

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