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Gliding arc plasmatron- plasma chemical reactor for methane conversion

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A gliding arc plasmatron (GAP) is applied as part of plasma chemical reactor for methane conversion and synthesis of carbon containing materials without associated carbon dioxide production. This plasma source can be operated in two different modes, namely gliding arc channel with diameter of 0.2-0.3 mm in a vortex gas flow and “plasma plume” mode, with one (or several) hot and broad plasma object(s) with diameter 4-5mm incorporated into the gliding arc channel. Plasma conditions and efficiency of methane conversion in these two modes are very different. The first GAP mode is characterized by a gas temperature of 2000K-2500K, electron density of about 10^{14} cm^{-3} and methane dissociation frequency of about 10 s^{-1}. Under these plasma conditions manly formation of methyl radicals by methane dissociation is expected. Plasma of “plasma plume” is very hot – 5500K-6000K, electron density amounts to about 10^{15} cm^{-3} and frequency of thermal methane dissociation is about 10^{7} s^{-1}. Under these plasma conditions methane will be completely dissociated. With optimized GAP geometry, gas flow rate and electric current (200-300 mA) plasma plume has contact to the plasma reactor surface only via thin GA channels. At that material of electrodes is not thermal overloaded and no metal lines are observed in emission spectrum of plasmatron. Switching between modes is possible by variation of plasma reactor geometry and gas flow rate.

Keywords
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