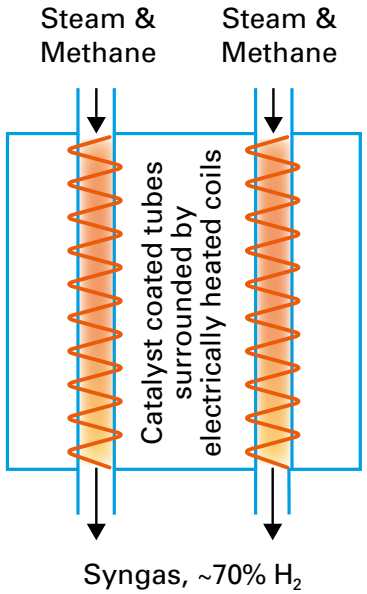
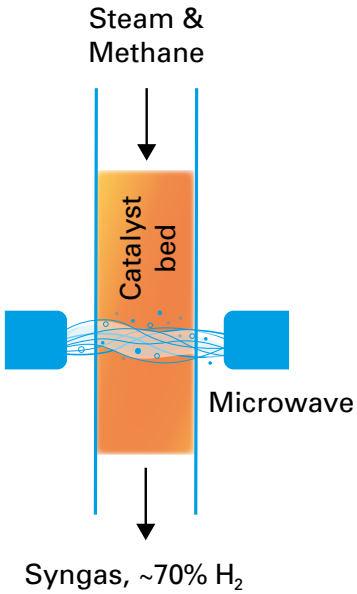
Electrically powered syngas and hydrogen production from methane

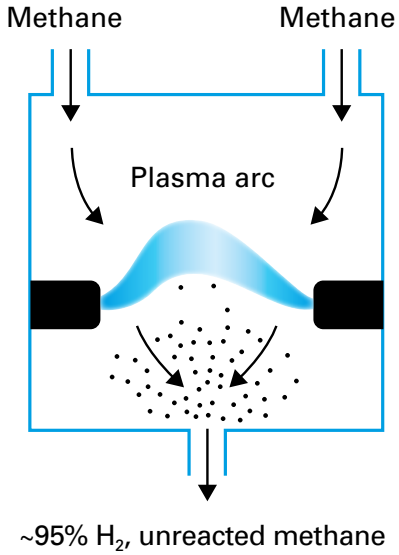
sbh4 consulting

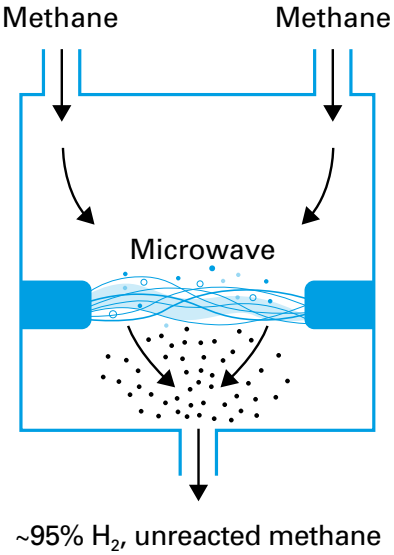
Notes:

- Combustion-heated SMR is an alternative to electrical heating
- Thermal or catalytic methane pyrolysis are alternatives
- Electrolysis is an alternative electrically powered pathway to produce hydrogen from water (AEC, AEM, PEM, SOE) or syngas from steam and carbon dioxide (SOE)
- Microwave plasma would be an alternative to dielectric microwave heating and would allow lower exit gas temperature









Process	Electrical Catalytic Steam Methane Reforming (eSMR)	Dielectric Microwave Catalytic Steam Methane Reforming (µSMR)	Plasma Pyrolysis of Methane (Methane Cracking, Methane Splitting)	Microwave Plasma Pyrolysis of Methane (Methane Cracking, Methane Splitting)
Carbon feedstock	Natural gas, refinery gas, naphtha or biomethane	Methane from natural gas or biomethane	Methane from natural gas	Methane from natural gas or biomethane
Target chemical reactions	$CH_4 + H_2O \rightarrow CO + 3H_2$	$CH_4 + H_2O \rightarrow CO + 3H_2$	$CH_4 \rightarrow C + 2H_2$	$CH_4 \rightarrow C + 2H_2$
Additional side reactions	$CO + H_2O \rightarrow CO_2 + H_2$	$CO + H_2O \rightarrow CO_2 + H_2$	$2CH_4 \rightarrow C_2H_2 + 3H_2$	$2CH_4 \rightarrow C_2H_2 + 3H_2$
Carbon produced as	CO and CO_2	CO and CO_2	Carbon black powder	Carbon black powder
Hydrogen content in product gas	~70%	~70%	~95%	~95%
Product gas pressure	10 to 40 bar	10 to 40 bar	Close to atmospheric pressure	Close to atmospheric pressure
Product gas temperature	~850 °C	500 °C to 850 °C	1500 to 2000 °C	1200 to 1500 °C