CO Selective Methanation – Effective Process for Hydrogen Purification

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NOVOROCS Technologies LLC

Novorocs Technologies

- Founded 2013
  - Joint Venture between Solid Cell & Unicat
  - Catalyst Development & Fabrication
  - Reactor Engineering & Manufacturing
  - System Design & Testing

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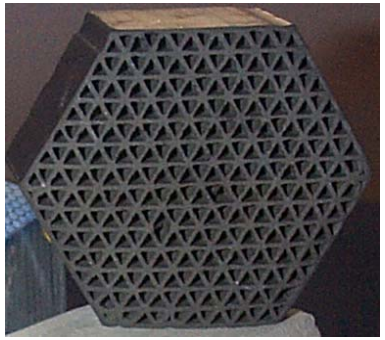
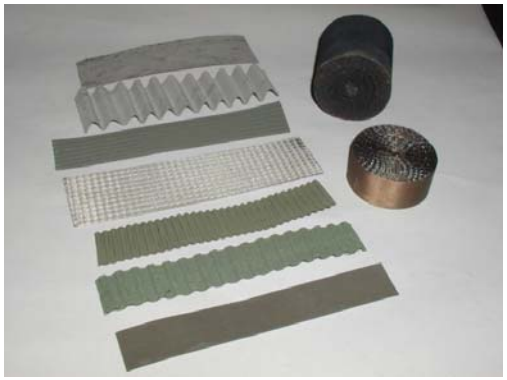
Catalytic Modules and Reactors for Syngas Production

Reforming Test Sets



Ceramic Catalyst

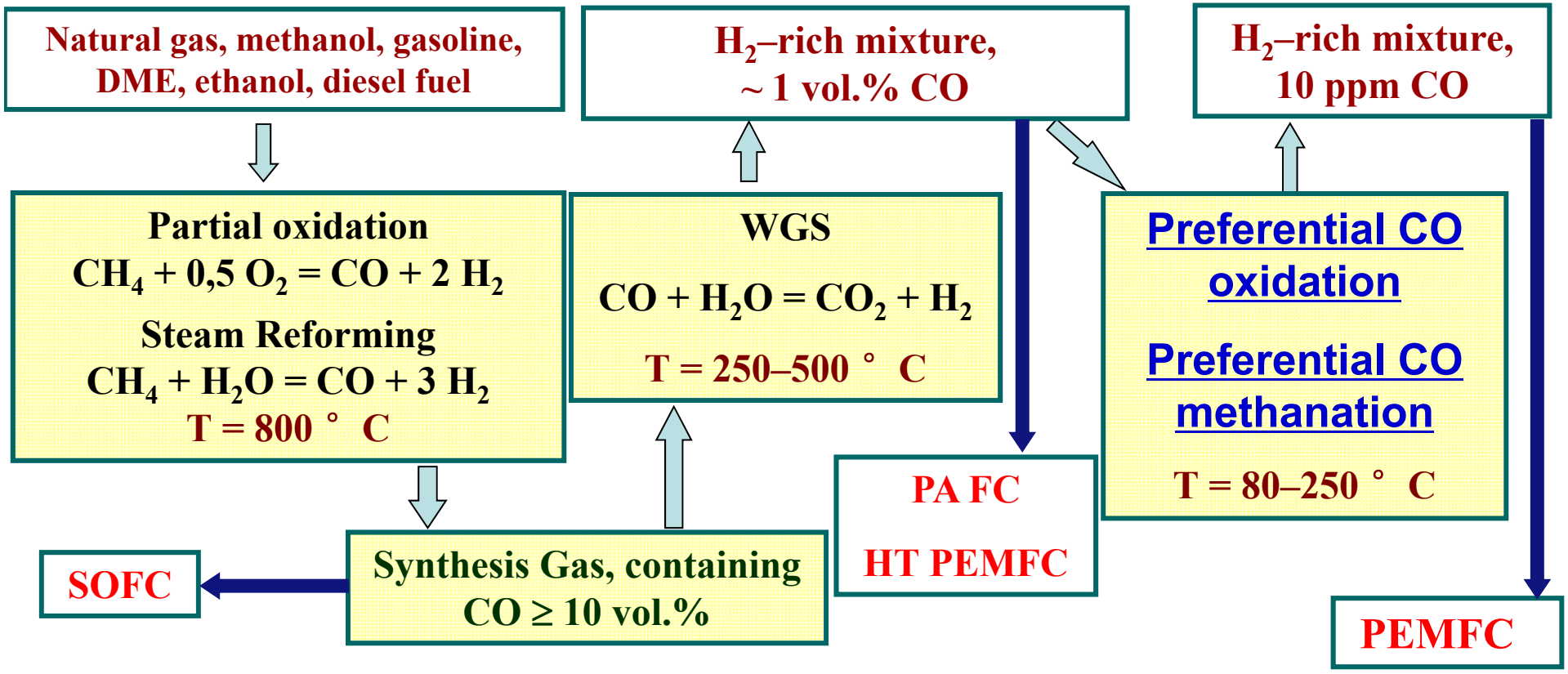


Foil, Solid and Porous Wafer Catalyst

Metal Foam Catalyst

Pilot Scale Systems

Syngas Production For Fuel Cells



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Possible Reactions

CO Preferential Oxidation

$2CO + O_2 = 2CO_2$

$2H_2 + O_2 = 2H_2O$

$CO_2 + H_2 = CO + H_2O$

CO Preferential Methenation

$CO + 3H_2 = CH_4 + H_2O$

$CO_2 + 4H_2 = CH_4 + 2H_2O$

$CO_2 + H_2 = CO + H_2O$

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CO Preferential Methanation

+ Simpler System Design (Syngas Simply Passes Through Reactor - No Additional Ga Streams)
+ free of nitrogen dilution.
+ produced methane is combusted in the outlet anode gas converter
+ heat released is used to support endothermic reaction of steam reforming of initial fuel
- low catalyst performance
- high hydrogen waste.

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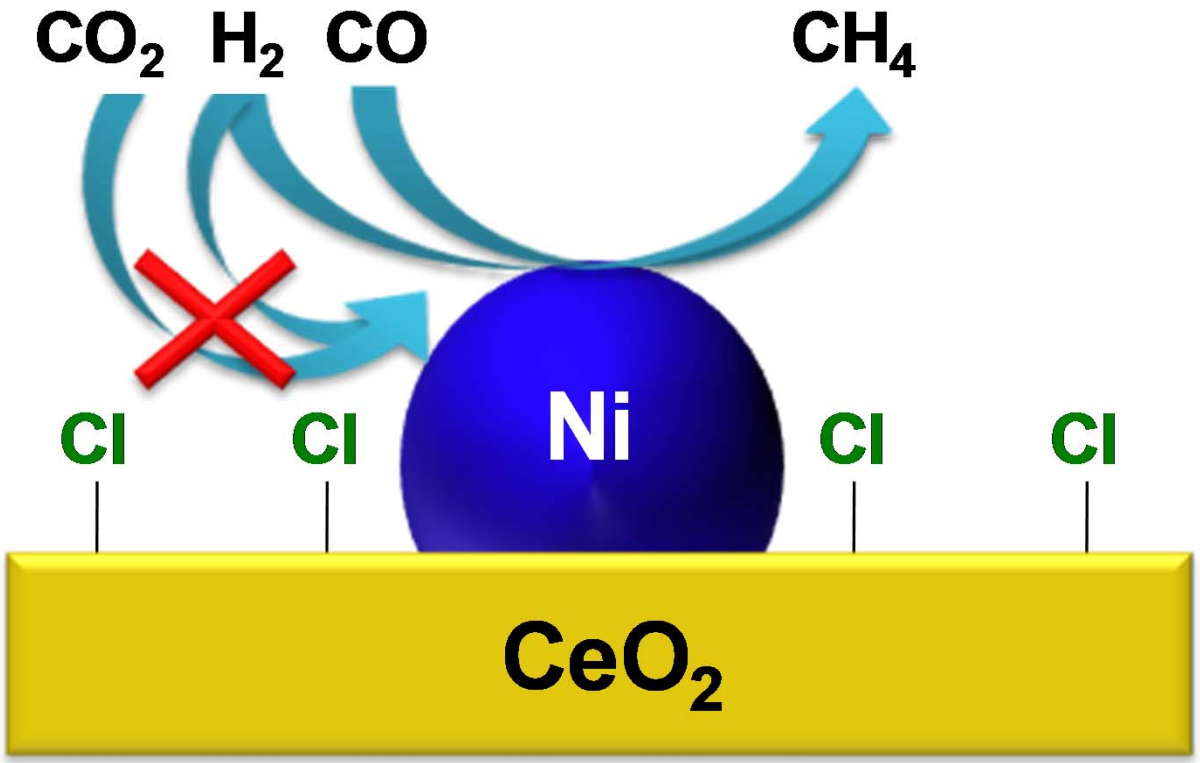
Preferential Methanation Reaction



- CO and H_2 are activated over the Ni surface.
- CO_2 is activated over the CeO_2 surface through formate species.
- Chlorine blocks the ceria surface and inhibits the CO_2 methanation.

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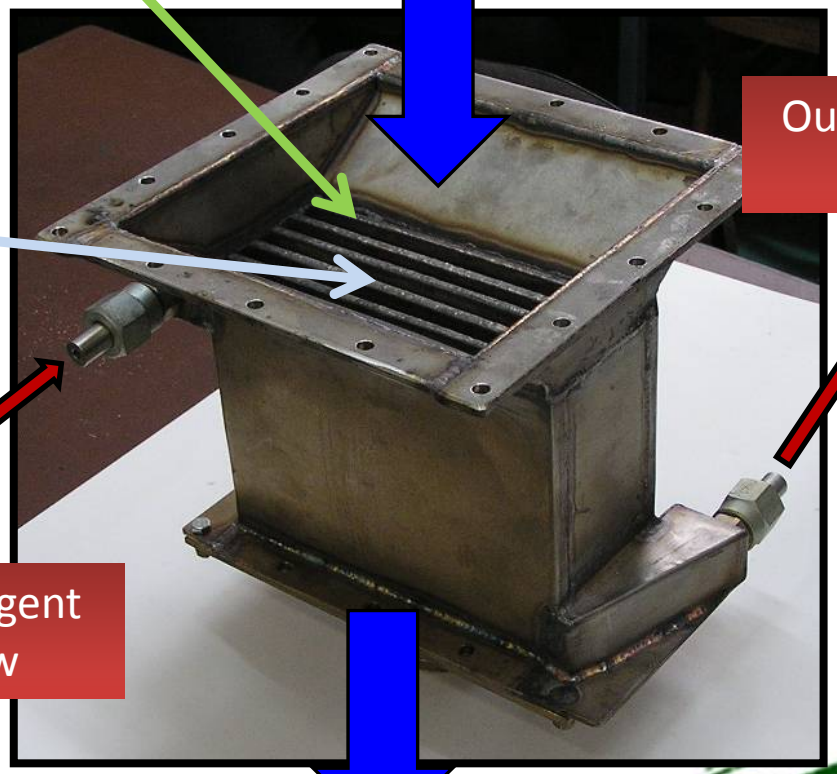
CO Preferetial Methanation Reactor

5 structured catalyst layers (black)
(size: LxWxH=10x20x0.95 cm)
Each contains 5 planar plate and 4 corrugated metal gauzes with catalyst

6 splits (grey)
(size: LxWxH=10x20x0.5 cm)
Each contains 1 planar plate and 2 corrugated metal gauzes



H_2-rich gas from WGS reactor

Outlet cool agent (air) flow

Inlet cool agent (air) flow

H_2-rich gas

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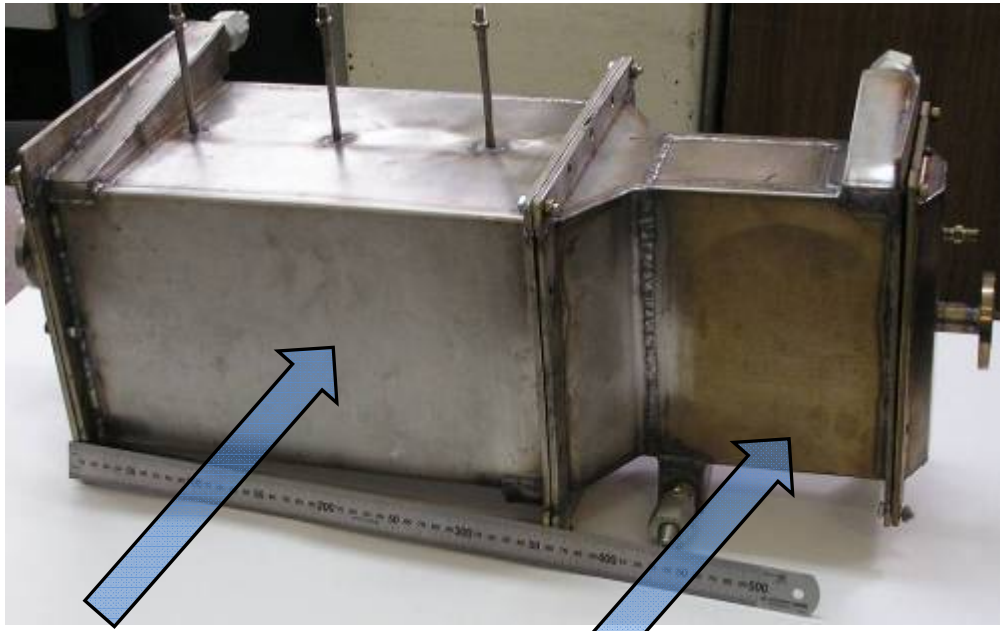
CO WGS and CO Preferential Methanation



CO WGS Reactor

Methanation Reactor

Productivity ~ 5 m^3 H_2/hr

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Reactor Testing

Flow rate, m^3/h	Inlet gas mixture, vol. %	T_{inlet}, °C	Average T in the CO PrMeth reactor, °C	$[CO]_{outlet}$, ppm
2.8	CO 0.3 CH_4 0.65 CO_2 15.9 H_2O 17.7 H_2 65.5	270	260	**8-10**
4.8	CO 0.47 CH_4 1.0 CO_2 15.8 H_2O 17.7 H_2 65.5	270	280	**10-15**

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Thank you!

Please visit us at booth D37

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