

-continued

Parameter	Value
Fuel contact time	3.3 ms
CH <sub>4</sub> Conversion (at 850° C.)	75%
H <sub>2</sub> Selectivity (at 850° C.)	72%
CO Selectivity (at 850° C.)	91%
Pressure drop	2.1 psi

## EXAMPLE 5

[0143] A fin having the same dimensions as the fin in Example 4 is cleaned in iso-propanol for 20 min with sonication. After drying at 100° C. for 1 hour and cooling to room temperature, the fin is cleaned in 20 wt. % HNO<sub>3</sub> solution for 20 min with sonication. The fin is rinsed with deionized water until the pH value reaches 7. After drying at 120° C. for 1 hour, the fin is heated to 1000° C. in air at a heating rate of 3.5° C./min and calcined at 1000° C. for 8 hours in air. A dense Al<sub>2</sub>O<sub>3</sub> layer is generated after calcination. The Al<sub>2</sub>O<sub>3</sub> layer functions as a protection scale and also improves the adhesion between the coating and the fin. Al<sub>2</sub>O<sub>3</sub> sol (25 wt. %, Sasol 14N4-25) is coated onto the fin by dipping. The excess sol is removed by jetting air over the coated surface. The fin is dried at 120° C. for 1 hour and calcined at 450° C. for 4 hours at a heating and cooling rate of 3.5° C./min. The sol coating process is repeated 3 to 4 times until 17 mg of Al<sub>2</sub>O<sub>3</sub> loading per fin is achieved. 7.5 wt. % La(NO<sub>3</sub>)<sub>3</sub> solution is impregnated onto the fin by dipping. The fin is dried at 120° C. for 1 hour and calcined at 1000° C. for 4 hours in air at a heating and cooling rate of 3.5° C./min. 10 wt. % Rh(NO<sub>3</sub>)<sub>3</sub> solution is dropped onto the fin and the excess solution is blown out by compressed air. The fin is dried at 120° C. for 1 hour and calcined at 500° C. for 1 hour in air. The Rh(NO<sub>3</sub>)<sub>3</sub> solution coating is repeated once and the fin is calcined at 1000° C. for 4 hours. The Rh loading is 5.2 mg per fin.

[0144] The resulting fin supported catalyst is tested for partial oxidation of methane to syngas at 1 atmosphere using the pellet described in Example 2. The pellet is placed in a furnace. The catalyst is reduced with H<sub>2</sub> at 450° C. for 30 min before use. The feed gas compositions were 29.6% of CH<sub>4</sub> and 70.4% of air (CH<sub>4</sub>/O<sub>2</sub>=2/1), with 2361 ml/min of total flow rate (standard conditions). The contact time is 3.3 ms. The temperature of the furnace is adjusted to keep the pellet skin temperature at mid-length at 800° C. The temperature of the feed stream at the inlet of the furnace is at room temperature. The feed stream is preheated before entering the pellet. The length of tubing from the entrance of furnace to the pellet is ten feet. The outlet pressure of the product stream is atmospheric pressure. The pressure drop in the pellet is measured by capuhelic differential pressure gauge. The composition of product is analyzed with two-column Gas Chromatograph. The performance of the fin is measured in terms of CH<sub>4</sub> conversion, H<sub>2</sub> selectivity and CO selectivity. The performance of the fin supported catalyst after 600 hours of steady-state operation is indicated below.

Parameter	Value
Coating Type	Sol wash-coat
Fuel composition	29.6% CH <sub>4</sub> , 70.4% air
Fuel contact time	3.3 ms
CH <sub>4</sub> Conversion (at 800° C.)	71%
H <sub>2</sub> Selectivity (at 800° C.)	70%
CO Selectivity (at 800° C.)	87%
Pressure drop	1.4 psi

[0145] The foregoing fin supported catalyst is tested with an n-butane and CH<sub>4</sub> fuel mixture. The feed gas contains 7.2% CH<sub>4</sub>, 7.2% n-butane and 85.6% air with a total flow rate of 2091 ml/min. A four column gas chromatograph is used to analyze the outlet gas composition. The temperature of the furnace is adjusted to keep pellet skin temperature at mid-length at 800° C. The performance of the fin supported catalyst after 300 hours of operation is summarized below.

Parameter	Value
CoatingType	Powder slurry wash-coat
Fuel composition	7.5% CH <sub>4</sub> , 7.5% n-butane, 85% air
Fuel contact time	3.3 ms
CH <sub>4</sub> Conversion (at 800° C.)	60%
n-butane conversion (at 800° C.)	76%
H <sub>2</sub> Selectivity (at 800° C.)	77%
CO Selectivity (at 800° C.)	82%
Pressure drop	1.0 psi

## EXAMPLE 6

[0146] A sorption separation unit having the design illustrated in FIG. 1 is made. A selective sorption medium sorbent is coated on the walls of the fins. The fins are made from aluminum and have a height of 1 mm, a width of 0.5 mm, and are spaced 0.5 mm apart. The base of the fin is 0.5 mm. The fin is inserted in a process microchannel with a height of 1.05 mm and a width of 5 cm. There are 50 fins within the microchannel. The process microchannel is adjacent to a heat transfer channel. Water is used as the heat transfer fluid to cool the unit for sorption and warm the unit for desorption. During desorption, a water stream at 65° C. flows through the heat exchange channel. During sorption, a water stream at 15° C. flows through the heat exchange channel.

[0147] A mixed feed of methane and nitrogen is fed to sorption unit. Methane preferentially sorbs on the sorption medium over nitrogen. Sorption occurs at 35° C. As the sorption medium is filled to capacity, the temperature of the sorption medium is increased to 55° C. by flowing a warm fluid through the heat exchange channel. The methane desorbs into the desorbant fluid which is methane or natural gas. After desorbing the methane, the temperature of the sorption medium is cooled to 35° C. for a second cycle of sorption. The cycle time between heating and cooling is 0.1 second.

[0148] While the invention has been explained in relation to various detailed embodiments, it is to be understood that