second reactor. In addition, the compositions indicate significant bypass within the reactor that is likely due to internal leaks. For example, the dehydrogenation steps are progressively slower, so neat perhydro-NEC (MW 207) would not be detected without the MW 203 intermediate unless there was bypass. Sample 150141-119-1 contained almost 11% feed without any MW 203 intermediate. Yield from the NEC that was converted reached almost 90%.

TABLE 2

Samples obtained from operating half of the PoP III reactor with corresponding average reactor temperature, H_2 flow and yield.

Sample	Feed flow (ml/min)	Time on stream (min)	Reactor temp (° C.)	H_2 flow (sccm)	H_2 yield[a]
15041-119-1	1.0	0-15	230	300	50%
15041-119-2	1.0	20-30	230	180	30%
15041-120-1	0.5	60-100	230	140	45%
15041-120-1	1.0	120-130	230	180	30%

[a]Based on H_2 flow.
[b]May contain some liquid from earlier time.

TABLE 3

Compositions determined by gas chromatography and mass spec of samples obtained during operation of the PoP III half-reactor.

Sample	MW 207	MW 203	MW 199	MW 195	H_2 yield (GC/MS)	Converted H_2 yield[a]
15041-119-1	10.9%	0%	30.3%	58.8%	79.1%	88.7%
15041-119-2	27.3%	16.0%	28.6%	28.1%	52.6%	72.2%
15041-120-1	20.6%	15.6%	32.0%	31.8%	58.3%	73.5%
15041-120-2	35.9%	19.4%	29.4%	15.4%	41.4%	64.7%

[a]Yield from the perhydro-NEC that was converted to at least MW 203.

The Proof-of-Principle reactor shown in FIG. **10** was taken apart, the four suspended-slurry sheets were replaced, and the reactor reassembled with new gaskets. Additional testing was performed with both of the clamshell reactors operating over a range of flow of perhydro-NEC and at 190° C., 200° C., 220° C., and 240° C. The data in FIG. **14** show measurements of the amount of H_2 produced from the reactor at a given temperature and feed flow rate of carbazole along with curves fitted to the data. The fitted curves are converted to conversion rates by mass balance which are shown in FIG. **15**. FIG. **15** also shows the calculated average residence time based on the internal void volume in the reactor and the feed flow rate. The reactor was able to produce over 1 liter of hydrogen at 240° C. with 42% conversion of carbazole at a feed flow rate of 4.0 ml/min of carbazole feed.

Moderate success was achieved in meeting the objectives of the Proof-of-Principle reactor. While H_2 flow required for 100 W_e equivalent power was achieved, it was at significantly lower than the 90% target H_2 yield. This was attributed to both external and internal leaks which prevented all the feed from being processed through the suspended slurry. Assuming all of the unreacted perhydro-NEC was bypass, then the H_2 yield approached the desired 90%. Developing better control of the suspended slurry thickness in the fabrication process and future design modifications will alleviate these difficulties.

The core of the Proof-of-Principle reactor—the active suspended-slurry area times the stack height including heat exchangers—that would need to be scaled-up for a given application is 75 ml and has a heat exchange area to volume ratio of 149 m^2/m^3. Achieving the design goal of 100 W_e equivalent power at 90% LOHC conversion would give a power density of 1.3 kW/L. This translates into a total reactor volume of 45 liters (1.6 ft^3) for a 60 kW_e primary power plant for a vehicle. There is high confidence that this is achievable with additional suspended-slurry development and reactor design iterations. In addition, the power density could be increased by 2.4× if the best measured suspend-slurry performance was realized in a reactor. Furthermore, there is the potential for an increase of 33× if the suspended-slurry performance were to approach the intrinsic kinetics of the catalyst.

FIG. **16** illustrates an exploded assembly view of a suspended-slurry reactor **600**, in accordance with another embodiment of the present invention. The reactor **600** includes heat exchanges **610**, reactor plates **620**, and a gasket **630**. The reactor **600** also includes feed channels **615**, effluent channels **640**, porous metal sheets **660**, and suspended-slurry sheets or membrane **670**. The reactor **600** further includes an inlet **602**, an outlet **604**, tubes for thermocouples **635**, and bolts **690**.

The present invention has been described in terms of specific embodiments incorporating details to facilitate the understanding of the principles of construction and operation of the invention. As such, references herein to specific embodiments and details thereof are not intended to limit the scope of the claims appended hereto. It will be apparent to those skilled in the art that modifications can be made in the embodiments chosen for illustration without departing from the spirit and scope of the invention.

We claim:

1. An apparatus for generating a large volume of gas from a liquid stream, comprising:

a. a first channel through which the liquid stream passes;

b. a layer of catalyst particles suspended in a solid slurry, through which the liquid stream passes from one side of the catalyst layer to the other, for generating gas from the liquid stream; and

c. a second channel through which a mixture of converted liquid and generated gas passes, wherein the first and second channels are located on opposite sides of the catalyst layer.

2. The apparatus of claim **1** further comprising a heat exchange channel for heating the liquid stream.

3. The apparatus of claim **1** further comprising a wicking structure located in the second channel for separating the gas generated from the converted liquid.

4. The apparatus of claim **1** wherein the liquid stream is a liquid organic hydrogen carrier and the generated gas is hydrogen.

5. The apparatus of claim **1** wherein the catalyst particles comprise at least one of the following: Pt/Al_2O_3 and Pd/Al_2O_3.

6. The apparatus of claim **1** wherein the catalyst particles are approximately 2 μm or less.

7. The apparatus of claim **1** wherein the solid slurry consists of catalyst particles held together in a solid-like matrix with a polymer.

8. The apparatus of claim **7** wherein the polymer is Teflon.

9. The apparatus of claim **7** wherein the catalyst particles comprise at least 90% by mass of the solid slurry.