Attorney Docket No.: 438/35/3 PROV

Hydrogen-Absorbing Insert for the LENR Tube

TECHNICAL FIELD

[0001] This disclosure is related to providing a hydrogen-absorbing material that can be, for example, inserted into an LENR tube, as more fully described in patent application no. 62/263,121, titled “Methods and Apparatus for Triggering Exothermic Reactions,” filed December 4, 2015, which is incorporated herein and is available as a priority document of PCT application PCT/US2017/013931, published as WO2017127423 on July 27, 2017.

BACKGROUND

[0002] The present embodiment of the LENR tube (“LT”) as described in US provisional patent application no. 62/263,121 requires that hydrogen-absorbing material be plated onto the inner wall of the LT or onto the slender central electrode. This disclosure provides a method to insert and remove a solid cylindrical object into the LT that will serve as the hydrogen-absorbing material.

[0003] In existing technologies, a powder-based catalyst filling the interior of the cylinder deprives the system of using plasma physics methods during operation of the reactor. Catalyst plated onto the inner wall of the reactor is an improvement over the powder-based method but the amount of catalyst available for use is difficult to accurately determine. Further, plated catalyst is not mechanically robust and it is challenging to plate large amounts of catalyst. Removing and replacing the plated catalyst is time-consuming, as the sidewalls must be scraped with a metal brush prior to re-plating. The material collected by scraping is then typically sent to a lab for species analysis to determine if nuclear ash can be found. The amount of material plated and subsequently removed from the inner walls is typically 0.1g. The small mass limits the ultimate power output of the reactor and limits the extent of the analytical methods used to study the spent material.

[0004] At the present time, hydrogen-absorbing material is plated onto the interior wall of the LT in a separate electrochemical bath. Electrochemical processes control plating quality. When the plated material is changed for different plated material, the used plated material is scraped from the inner wall or from the central removable electrode using a steel brush. It is often desirable to recover as much of the plated material as possible for analysis after reactor operation.

[0005] There are problems with existing technologies. The plating method described in patent application no. 62/263,121 was effective in producing usable heat; however there are some disadvantages associated with plating the inner wall of the LT or the slender central electrode.

[0006] Plating the inner wall of the LT does not provide good visibility of the plated surface or analytical access to the deposit. The plating must be scraped with a steel brush to remove the deposit and does not collect all of the deposit. Plating the slender central electrode provides for a reduced volume of plated deposit. Plating the slender central electrode provides limited thermal coupling to the reactor walls, where the heat is most useful. Plated deposits are not as robust as solid materials.

SUMMARY

[0007] This summary is provided to introduce in a simplified form concepts that are further described in the following detailed descriptions. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it to be construed as limiting the scope of the claimed subject matter.

[0008] According to at least one embodiment, a catalyst insert for a tubular reactor device includes an insert body having a structural heat-conducting exterior and a hydrogen doped metal interior.

[0009] The insert body may have a cylindrical shape. The heat-conducting exterior may include, for example, copper or nickel. The metal interior may include a hydrogen-absorbing metal.

[00010] The insert body may be formed by directing a stream of heated atomized particles from a thermal spray head onto a first side of a plate, and forming the plate into the insert body with the first side of the plate defining the hydrogen doped metal interior.

[00011] The thermal spray head may include a nozzle through which an oxygen fuel gas mixture flows to heat and melt a metal stock and a compressed gas flow propels the stream of heated atomized particles.

[00012] The catalyst insert may include a hook or loop attached to the insert body for extracting the catalyst insert from a tubular reactor device.

[00013] Holes may be formed in the insert body for engagement with a tool for manipulation of the catalyst insert in a tubular reactor device.

[00014] The insert body is preferably electrically conductive, and may be formed of or include copper.

[00015] The interior of the insert body may include a gold layer, which may be deposited by electroplating.

[00016] The interior of the insert body further may have a second layer that includes palladium. The second layer may further include yttrium.

BRIEF DESCRIPTION OF THE DRAWINGS

[00017] The previous summary and the following detailed descriptions are to be read in view of the drawings, which illustrate particular exemplary embodiments and features as briefly described below. The summary and detailed descriptions, however, are not limited to only those embodiments and features explicitly illustrated.

[00018] FIG. 1 is an elevational view of a catalyst insert according to at least one embodiment.

[00019] FIG. 2 is cross-sectional view of a metallic spraying apparatus according to at least one embodiment.

DETAILED DESCRIPTIONS

[00020] These descriptions are presented with sufficient details to provide an understanding of one or more particular embodiments of broader inventive subject matters. These descriptions expound upon and exemplify particular features of those particular embodiments without limiting the inventive subject matters to the explicitly described embodiments and features. Considerations in view of these descriptions will likely give rise to additional and similar embodiments and features without departing from the scope of the inventive subject matters. Although the term “step” may be expressly used or implied relating to features of processes or methods, no implication is made of any particular order or sequence among such expressed or implied steps unless an order or sequence is explicitly stated.

[00021] Any dimensions expressed or implied in the drawings and these descriptions are provided for exemplary purposes. Thus, not all embodiments within the scope of the drawings and these descriptions are made according to such exemplary dimensions. The drawings are not made necessarily to scale. Thus, not all embodiments within the scope of the drawings and these descriptions

are made according to the apparent scale of the drawings with regard to relative dimensions in the drawings. However, for each drawing, at least one embodiment is made according to the apparent relative scale of the drawing.

[00022] The Hydrogen-Absorbing Insert described herein and illustrated in FIG. 1 has these advantages over the present plated methods:

1. The insert can be prepared using plating or any other metallurgical process.
2. The size and volume of the insert is controllable. Reactor power is proportional to the insert volume containing the hydrogen-absorbing material.
3. The insert can be made more robust than the present plated deposits.
4. The cylindrical insert can be press-fit into the LT and maintain good thermal contact with the walls, where heat is most useful.
5. The insert can be removed using an extractor tool.
6. The insert can be easily transferred to an analytical lab for testing.
7. The insert allows the operator to recover all of the active material for testing.

[00023] In practice, a band or cylinder may be machined out of a non-precious metal with good thermal conductivity. This could be 316L stainless steel because of its hydrogen containment advantages and because it would match the thermal expansion properties of the LENR Tube into which it is to inserted. The insert is machined to provide a snug fit into the LT, perhaps using a thermal coating such as Wat-Lube provided by Watlow to aid in metal extraction and thermal transfer. The insert length is variable and is limited by the length of the LT and by how much catalyst volume is required. Reactor power is dependent upon, and may be directly proportional to catalyst volume. The length of the insert band might range from one to six inches.

[00024] Before insertion, the band or cylinder is plated in an external bath where the deposit can be easily viewed or analyzed. The insert can also be processed using any known metallurgical technique to provide the desired solid state or crystalline properties, such as metallic spraying as depicted in FIG. 2. Nano surfaces or layered surfaces can be created. Complete control over the metallurgical aspects of the insert can be obtained. The insert is placed into an LT reactor for testing and operation. An extraction tool can be used to remove the insert and replace it with a new insert. In

this way, various insert configurations can be tested, or a depleted insert could be replaced as necessary.

[00025] Since the inserts are design to fit snuggly into an LT for proper electrical connections, an extraction tool may aid in insert manipulation. To aid insertion and extraction, in one embodiment, the tubes have two quarter inch holes drilled 180 degrees apart. An extraction tool can be fabricated using a 6 inch inside caliper, as used by machinists, adapted by bending the tongs to a right angle and then grinding to fit the insert tube. This allows the caliper to be expanded to fit the insert holes for easy removal and insertion into the LT. It should be noted that other similar modifications by those skilled in the art can be made to aid in manipulating the insert.

[00026] FIG. 2 shows a metallic spraying apparatus, which uses thermal spraying. Plating is accomplished by feeding a pure metal or alloy feed stock 10 into the thermal spray head. The metal is melted and propelled forward by controllable compressed airflow 16. An oxygen fuel gas mixture 24 flows through the nozzle 14. An air cap 18 cups the forward end of the nozzle 14. A spray stream 20 of molten atomized particles is directed onto the plate 26 and a deposit 22 accumulates.

[00027] The speed of the airflow, the thickness of the metal wire 12 and its transport speed control the properties of the deposit 22. Varying the wire thickness and its transport speed can control the thickness and coarseness of the deposit. The formation of vacancies in a metal deposit may produce a higher thermal density, which is desirable. Deposit coarseness lowers the vacancy formation energy so more vacancies can be formed in the deposit. The method depicted schematically in FIG. 2 can control deposit coarseness and in turn influence the concentration of vacancies in the deposit.

[00028] The plate 26 and deposit 22 may be formed into, respectively, the hydrogen doped interior and the structural exterior of the catalyst insert of FIG. 1

[00029] A variation on the wire method depicted in FIG. 2 can also be used. The method uses a reservoir of metal powder that can be fed into the heated area of the thermal spray head. Metal powder can be fed into the heated area of the thermal spray head. Metal powder could then be used as the feedstock and has the advantage of alloying. A mixture of powders can be used to create a deposited alloy. Metal powder is also likely to provide more variation in deposit thickness, as the powder can be obtained in varying mesh sized ranging from coarse to fine.

[00030] These descriptions relate also to useful improvements in methods for producing a thermally active insert. As reactor output may be directly and linearly proportional to an applied

external magnetic field. In practice, magnets may be placed externally with respect to the hydrogen-absorbing catalyst, which provides for a weakened magnetic field at the catalyst.

[00031] A hydrogen-absorbing catalyst can be electroplated directly onto a magnetic surface, for example, of about 3000 Gauss in one embodiment. This provides a magnetic field within the catalyst that is 15 times stronger than using external magnets of about 200 Gauss. Subject to mechanical limitations, this configuration has the potential to produce thermal power at a level several times greater than other configurations.

[00032] In some embodiments, curved cylindrical magnets each having of a north pole and a south pole are utilized. The curved magnets can be electroplated with a hydrogen-absorbing metal or sprayed as depicted in FIG. 2. The magnetic pole pieces can then be inserted into a cylindrical reactor to serve as the inserts, for example as described above with reference to FIG. 1.

[00033] Various metal tubing can be used for construction of the inserts depending on the requirements for specific utilizations. Adequate electrical conductivity is preferred in many embodiments.

[00034] In one embodiment, ¾ inch nominal type L copper plumbing tube is used. This allows for good electrical conductivity and also a good substrate onto which the active materials can be plated. Six inch length tubes can be machined and sanded down to 0.86 inches to snuggly fit into the approximately 7/8 inch ID LT housing. The tubes can be wire brushed and then cleaned with 3N HCl.

[00035] In one insert embodiment, the inside surface is plated with gold using a gel brush plating. For example, a commercially available gel brush plating from Gold Smith, Inc. can be used. This can be used as a control insert for calibration purposes. In another embodiment, gold plating as above is first used and then plated with a palladium-based material. This is accomplished by using a platinum plated quarter-inch titanium anode and a solution of palladium chloride containing an additional 2% yttrium fluoride. The yttrium is added to enhance the diffusion rate of hydrogen in and out of the palladium.

[00036] In another embodiment, both rubidium and thorium nitrate at 1% is added to lower the required ionization potential needed to strike discharges to the surface.

[00037] The inserts have been found to be active within the LT and yielded approximately 2 to 5 watts of power with sporadic bursts of up to 20 watts.

[00038] Particular embodiments and features have been described with reference to the drawings. It is to be understood that these descriptions are not limited to any single embodiment or any particular set of features, and that similar embodiments and features may arise or modifications and additions may be made without departing from the scope of these descriptions and the spirit of the appended claims.

CLAIMS

What is claimed is:

1. A catalyst insert for a tubular reactor device, the catalyst insert comprising:
an insert body having a structural heat-conducting exterior and a hydrogen-doped metal interior.

2. The catalyst insert of claim 1, wherein the insert body has a cylindrical shape.

3. The catalyst insert of claim 1, wherein the heat-conducting exterior comprises at least one of copper and nickel.

4. The catalyst insert of claim 1, wherein the metal interior comprises a hydrogen-absorbing metal.

5. The catalyst insert of claim 1, wherein the insert body is formed by directing a stream of heated atomized particles from a thermal spray head onto a first side of a plate, and forming the plate into the insert body with the first side of the plate defining the hydrogen doped metal interior.

6. The catalyst insert of claim 5, wherein the thermal spray head comprises a nozzle through which an oxygen fuel gas mixture flows to heat and melt a metal stock and a compressed gas flow propels the stream of heated atomized particles.

7. The catalyst insert of claim 1, wherein further comprising a hook or loop attached to the insert body for extracting the catalyst insert from a tubular reactor device.

8. The catalyst insert of claim 1, wherein holes are formed in the insert body for engagement with an extraction tool for manipulation of the catalyst insert in a tubular reactor device.

9. The catalyst insert of claim 1, wherein the insert body is electrically conductive.

10. The catalyst insert of claim 9, wherein the insert body comprises copper.

11. The catalyst insert of claim 1, wherein the interior of the insert body comprises a gold layer.

12. The catalyst insert of claim 11, wherein the gold layer is deposited by electroplating.

13. The catalyst insert of claim 11, wherein the interior of the insert body further comprises a second layer including palladium.

14. The catalyst insert of claim 13, wherein the second layer includes yttrium.

15. The catalyst insert of claim 1, wherein the insert body comprises at least one magnet.

16. The catalyst insert of claim 15, wherein the magnet is plated with a hydrogen-absorbing material.

17. The catalyst insert of claim 1, wherein the insert body comprises two magnetized regions serving as north and south magnetic poles respectively.

ABSTRACT

A catalyst insert for a tubular reactor device includes an insert body having a structural heat conducting exterior and a hydrogen doped metal interior. The insert body may have a cylindrical shape. The heat-conducting exterior may include, for example, copper or nickel. The metal interior includes a hydrogen-absorbing metal. The insert body may be formed by directing a stream of heated atomized particles from a thermal spray head onto a first side of a plate, and forming the plate into the insert body with the first side of the plate defining the hydrogen doped metal interior.

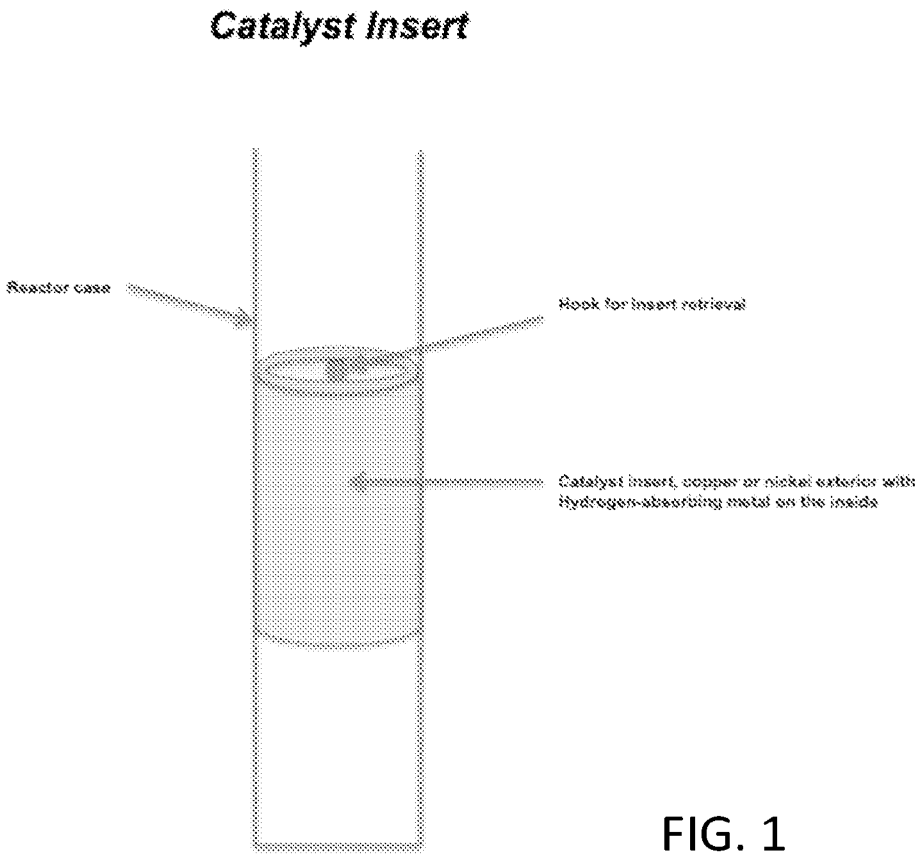
Catalyst Insert
Reactor case
Hook for insert retrieval
Catalyst insert, copper or nickel exterior with
Hydrogen-absorbing metal on the inside

FIG. 1

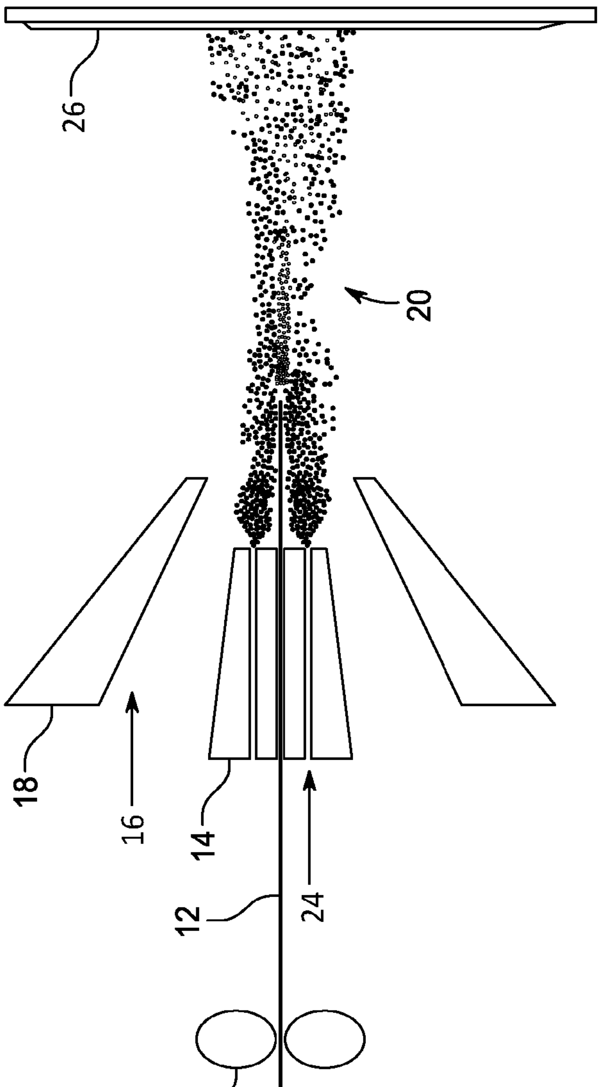

FIG. 2