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(54) **CATALYTIC BURNER FOR COMBUSTION OF LIQUID FUELS**

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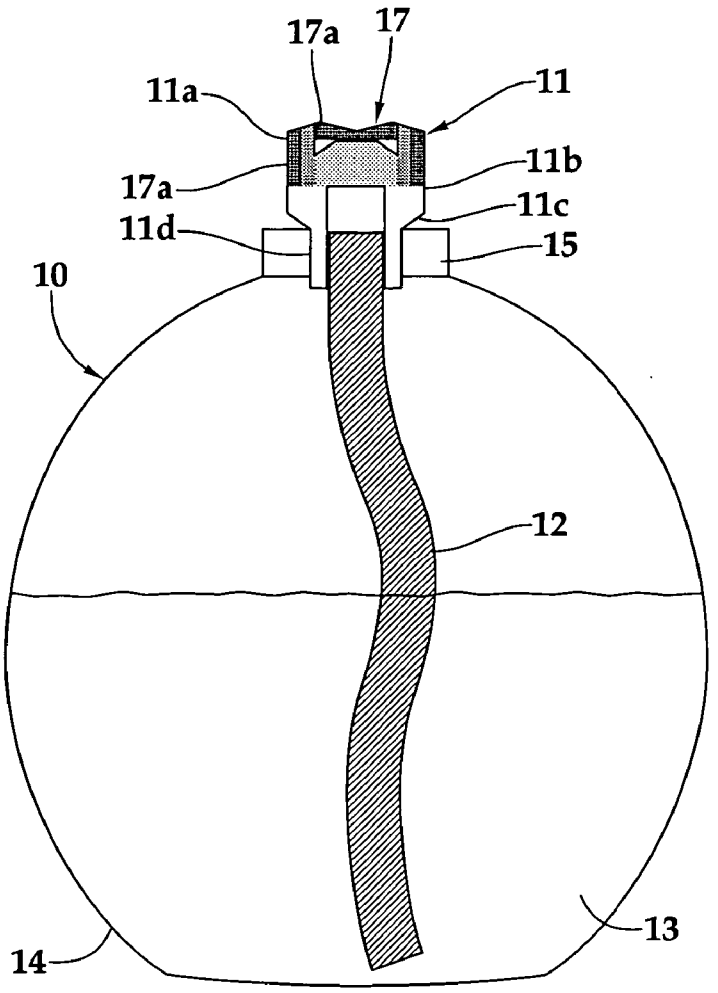
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(57) **ABSTRACT**

Flameless catalytic burner systems made of zeolites that have a higher working temperature and greater flow rate than existing flameless catalytic burners have been developed. The burner systems comprise wicks that are capable of wicking low vapor pressure fuels.



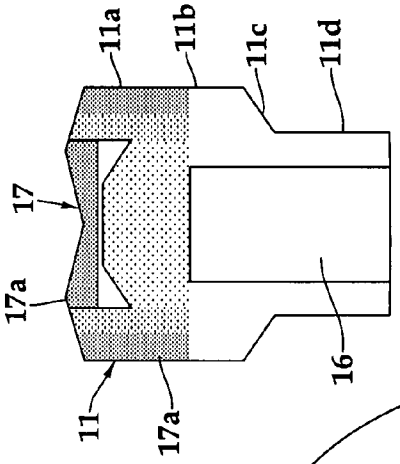


Fig.3

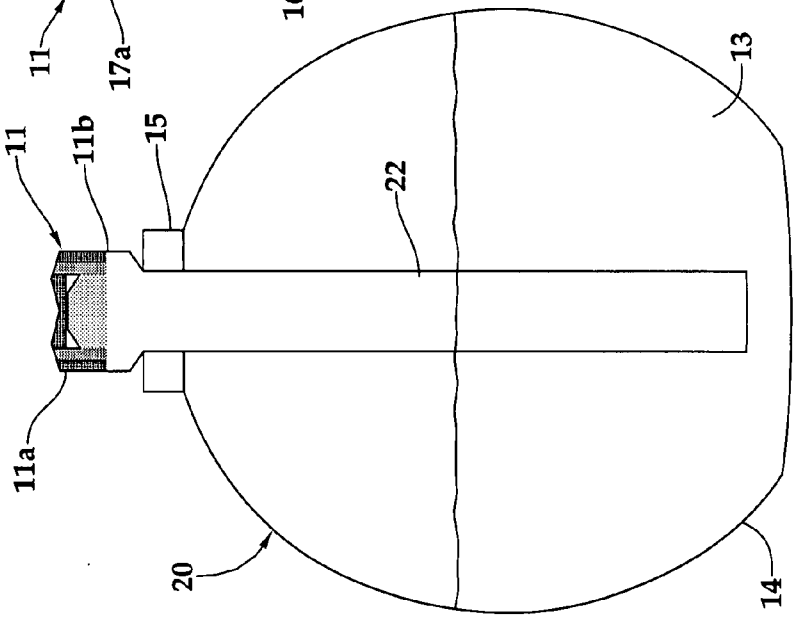


Fig.2

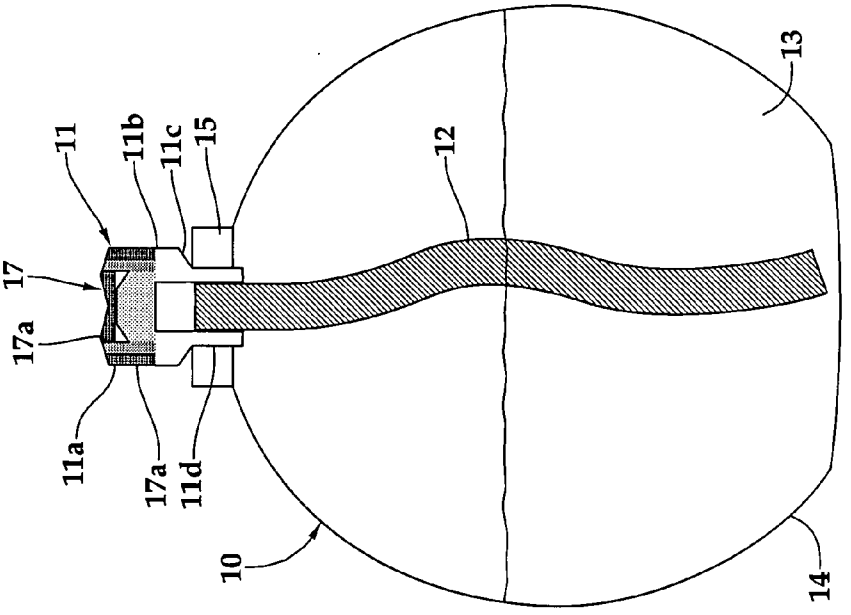


Fig.1

CATALYTIC BURNER FOR COMBUSTION OF LIQUID FUELS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/771,618, filed Feb. 8, 2006 and U.S. Provisional Application No. 60/771,918, filed Feb. 8, 2006.

BACKGROUND OF THE INVENTION

[0002] Currently, there are several flameless catalytic burners and lamps available on the market. Certain of these prior art devices are employed for the delivery of fragrance to a room or other area. The chemical delivery system (for the delivery of chemicals such as fragrances) employed in the prior art devices is based on the flameless combustion of a carrier solvent/fragrance mixture to deliver fragrance to the surrounding atmosphere. The system is composed of a reservoir for containing the solvent/fragrance mixture, and a wick that is attached to a macroporous flameless catalytic burner, to provide flow from the reservoir to the burner. Prior art flameless catalytic burners are typically 2.0 cm in length having an upper portion that is typically 1.7 cm in diameter, and a lower portion that is typically 1.1 cm in diameter. The upper portion contains the catalyst and performs the combustion, while the smaller, lower portion connects to a wick, typically made of cloth. The cloth wick transports the fuel from the reservoir to the catalytic burner.

[0003] The solvent/fragrance mixture is approximately 90 wt % 2-propanol, 2 wt % essential oils (fragrance), and 8 wt % water. This mixture is transported through the cloth wick to the catalytic burner, where the 2-propanol is catalytically combusted, the heat of which vaporizes the fragrance. Vaporization of the fragrance increases the rate at which it is dispersed into the surrounding atmosphere. The 2-propanol-based fuel is typically combusted by a commercial platinum catalyst at approximately 215° C. The prior art catalytic burners are composed of macroporous ceramic support materials that are formed from nonporous materials, such as cristobalite, and are capable of absorbing the solvent/fragrance mixture. There are several disadvantages associated with the prior art catalytic burners. Firstly, they achieve only partial combustion of the 2-propanol fuel such that acetone and the volatile organic compound (VOC) 2-propanol are released into the atmosphere as pollutants. Partial combustion also results in coke build-up that reduces catalyst efficiency and eventually deactivates the catalyst. Secondly, the catalyst layer is located only on the outer surface of the burner, and does not penetrate into the interior regions of the burner. This arrangement requires the fuel to travel farther up into the burner before combustion can take place. Another drawback to the prior art burners is that because of their low porosity or lack of porosity, they cannot absorb low vapor pressure (LVP) fuels at a rate sufficient to sustain catalytic burning of the fuels. LVP fuels are generally more desirable because they generate fewer VOC pollutants than traditional fuels.

[0004] In light of the disadvantages discussed above, there is therefore a need for a flameless catalytic burner system that can overcome the problems prevalent in presently available devices.

SUMMARY OF THE INVENTION

[0005] The invention is directed to a catalytic burner system comprising a burner constructed of at least one molecule sieve, where the burner comprises an upper portion and a lower portion; a catalyst, wherein said catalyst is dispersed within the upper portion of the burner; a wick, wherein said wick comprises an upper portion and a lower portion, the upper portion of the wick being connected to the lower portion of the burner; and, a reservoir, wherein said reservoir houses a liquid fuel that is contacted by the lower portion of the wick.

[0006] The invention is also directed to a method for combusting a liquid fuel comprising, a burner constructed of at least one molecular sieve, wherein said burner has a first, upper portion and a second, lower portion; providing a wick that is connected to the lower portion of the burner; providing a catalyst that is dispersed within the upper portion of the burner; providing a reservoir that contain liquid fuel; contacting the wick with the liquid fuel; and, transmitting the fuel from the reservoir to the burner through the wick.

BRIEF DESCRIPTION OF DRAWINGS

[0007] FIG. **1** is a longitudinal cross-section of a first catalytic burner system of the invention;

[0008] FIG. **2** is a longitudinal cross-section of a second catalytic burner system of the invention; and,

[0009] FIG. **3** is a longitudinal cross-section of a catalytic burner of the invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0010] An embodiment of the invention provides a flameless catalytic burner capable of absorbing fuels at a rate sufficient to maintain autocatalytic combustion.

[0011] An embodiment of the invention provides a burner that is constructed of highly porous crystalline materials, such as zeolites, which provides a flow rate of fuels that is sufficient to allow the catalyst to function, but low enough to prevent the fuel from extinguishing the catalyst. An optimal or preferred fuel travel rate in a zeolite-based burner is 0.6 ml/min.

[0012] In an embodiment of the invention, a molecular sieve-based burner is composed of a shaped structure comprising an upper portion that contains a catalyst. The lower portion of the burner does not contain catalyst, and is shaped with a shoulder that facilitates placement of the burner in a reservoir. The upper portion of the burner can be of any shape having linear edges including, pyramidal, octagonal, or hexagonal. This lower portion of the burner sits on top of a reservoir having a neck, which in turn permits the shoulder of the burner to contact the neck of the reservoir. The lower portion of the burner is connected to an upper portion of a wick. The lower portion of the wick contacts fuel located in the reservoir. The wick transports the fuel from the reservoir to the catalyst.

[0013] In certain embodiments of the invention, the wick is constructed from a porous material. In an embodiment of the invention, the wick is made of zeolites. In another embodiment of the invention, the wick is made of cloth, for e.g., woven cloth wick or a woven cotton wick. In certain

embodiments of the invention, the wick is constructed from porous materials other than zeolites, such as porous ceramic materials.

[0014] The wick of the present invention is a solid structure which, unlike wicks used in prior art burner systems, does not contain a concentric hole along its longitudinal centerline.

[0015] In certain embodiments of the invention, the fuel is a liquid fuel. The preferred liquid fuel for use is a LVP fuel that generates lower amounts of VOCs than traditional fuels.

[0016] An embodiment of the invention provides a zeolite-based flameless catalytic burner that can reach a higher working temperature than currently available burners. This feature reduces the emission of VOCs from the burner, which in turn reduces coking.

[0017] A specific industrial application for a catalytic burner is its use in a flameless lamp. However, one of ordinary skill in the art would readily recognize that the catalytic burner described herein has numerous industrial applications including, portable stoves, radiant heater, dispersant systems for various as fragrances, insecticides, aromatherapy compounds, fungicides and herbicides; heat producing components in portable heat pumps, micro-chemical reactor system, heat source in portable warmers, and any application in which a portable heater is required.

[0018] An embodiment of the invention relates to a catalytic burner made of a porous molecular sieve material on which a metal catalyst is supported. The porous structure absorbs fuel, which is catalytically combusted by catalyst that is supported on the burner.

[0019] As depicted in FIG. **1**, a catalytic burner system **10** comprising a burner **11** and wick **12** is shown. The burner **11** comprises an upper portion **11***a*, and a lower portion **11***b*. The lower portion of the burner **11***b* comprises a shoulder **11***c*. The burner **11** further comprises a vertical portion **11***d* that extends below the shoulder **11***c*. The lower portion of the burner tapers inward such that the diameter of the lower portion of the burner is smaller than the diameter of the upper portion of the burner. The diameter of the upper portion of the catalytic burner shown in FIG. **1** ranges from 1.0 to 2.0 cm, and the length of the burner ranges from 1.0 to 2 cm. A close-up view of the burner is illustrated in FIG. **3**.

[0020] The upper portion of the burner **11***a* comprises catalyst **17** that is distributed throughout the structure of the upper portion of the burner. The distribution of the catalyst is more concentrated on the peripheral portion of the burner **17***a*, than in the inner portion of the burner **17***b*. Thus a concentration gradient ranging from high to low is established from the peripheral portion of the burner to the inner portion of the burner.

[0021] The wick **12** is connected to the burner **11** by insertion into a space **16** located within the lower portion of the burner. The wick **12** may be removably or permanently connected to the burner **11**, depending on the type of wick used. The length of the wick **12** depicted in FIG. **1** is approximately 12 cm. The wick does not contain any catalyst, and is typically shaped like a cylinder and is smaller in diameter (0.5 to 1.5 cm) than the upper portion and has a length between 2.0 to 12.0 cm. In an embodiment of the invention, the wick ranges in length from 10 to 12 cm. The wick extends into the fuel reservoir and contacts the fuel present in the reservoir. The fuel is absorbed by the wick, and travels up the length of the wick to the burner. In the case of a porous wick, the fuel enters the pores of the wick and travels through the pores from the reservoir through the burner structure, and comes in contact with the catalyst.

[0022] The embodiment of the invention depicted in FIG. **2** is a catalytic burner system **20** having a burner **11** and a porous, non-cloth wick **22**. The wick **22** can be either removably or permanently connected to the burner **11**. All aspects of the catalytic burner system **20** show in FIG. **2** are similar to the system show in FIG. **1**, except for the difference in the type of wick used in the two systems.

[0023] The upper portion of the burner **11** containing the catalyst is contacted with a ignition source for igniting the catalyst such as lighter, match or any heat source that will cause the fuel to combust, in order to burn the fuel that travels up the wick from the reservoir to the upper portion of the burner.

[0024] The catalytic burner is constructed of highly porous materials such as molecular sieves. A particular type of molecular sieve that can be used in the construction of the burner includes zeolites. Zeolites are crystalline microporous aluminosilicates with pores having diameters in the range of 0.2 to 1.0 nm and high surface areas of up to 1000 m^2/g. Zeolite crystals are characterized by one to three-dimensional pore systems, having pores of precisely defined diameter. The corresponding crystallographic structure is formed by tetrahedras of (AlO_4) and (SiO_4), which form the basic building blocks for various zeolite structures. Due to their uniform pore structure, zeolite crystals exhibit the properties of selective adsorption and high adsorption capacities for LVP fuels. All zeolites have ion-exchange ability and can exchange H^+ for cations such as Na^+ and K^+.

[0025] Zeolites have a Si/Al ratio ranging from 1-[but preferably greater than 60. Examples of zeolites that may be used in the construction of catalytic burners include, without limitation, all forms of ZSM-5, silicalite, all forms of mordenite, all forms of zeolite Y, all forms of zeolite X, all forms of zeolite A, all MFI type zeolites, all faujasite type zeolites, all forms of zeolite β, all forms of zeolite UTD-1, all forms of zeolite UTD-12, all forms of zeolite UTD-13, all forms of zeolite UTD-18, all forms of MCM-22, all forms of ferrierite, and all naturally occurring zeolites. The burners of the claimed invention may also be constructed from mesoporous materials such as DAM-1, MCM-41, MCM-48, SBA-15, MSU, and MBS.

[0026] Zeolite-based burners are highly porous and allow the fuel to travel from the reservoir through the zeolite material at far greater rates than contemporary flameless catalytic burners constructed from macroporous materials. Typical fuel travel rates in zeolite-based burners are 0.2 ml/min to 0.8 ml/min. An optimal or preferred fuel travel rate in a zeolite-based burner is 0.6 ml/min. The surface area of the zeolite-based catalytic burners ranges from 10 m^2/g to 1000 m^2/g, and is preferably at least 400 m^2/g.

[0027] The zeolites are ion exchanged with combustion metal catalysts such as platinum, palladium, and rhodium and combinations thereof. This ion exchange process facilitates the uniform dispersion of the catalyst throughout the

structure of the burner. Additionally, the small pore size of the zeolites induces the formation of metal nanoparticles, which exposes a greater surface area of the metal catalysts and leads to more efficient and complete combustion of the fuel. The small pore size of the zeolites further facilitates an improvement in the level of VOC emissions because of their high adsorption capacities for LVP fuels relative to prior art burners made of macroporous materials. Thus, zeolite-based burners are environmentally friendly relative to prior art burners, particularly with respect to their improved VOC emissions and their ability to burn low LVP fuels.

[0028] An embodiment of the invention provides a zeolite-based flameless catalytic burner that can reach a higher working temperature (>275° C.) than currently available burner. This feature reduces the emission of VOCs from the burner, which in turn reduces coking. The increased operating temperature of the current invention is in part due to more efficient catalyst dispersion in the material, as well as the ability of the fuel to travel through the burner at faster and more uniform rate. Whereas current catalytic burners have the catalyst located only on the surface of the ceramic burner, a zeolite-based burner has catalyst dispersed throughout the structure of the burner by virtue of the ion exchange properties of zeolites.

[0029] In certain embodiments of the invention, the silicon/catalyst (Si/Cat.) ratio of the structure of the zeolite-based burner may range from 100 to 5. In an embodiment of the invention, the Si/Cat. ratio at the surface of the burner is approximately 25. This ratio decreases in a gradient-like manner from the surface to the center of the burner.

[0030] The burner of the claimed invention further comprises a binder. The binder, as used herein, refers to any material which upon heating, binds together to form a rigid structure. Examples of materials that can be used as binders include materials such as, without limitation, bentonite, hectorite, laponite, montmorillonite, ball clay, kaolin, palygorskite (attapulgite), barasym SSM-100 (synthetic mica-montmorillonite), ripidolite, rectorite, optigel SH (synthetic hectorite), illite, nontronite, illite-smectite, sepiolite, beidellite, cookeite, or generally any type of clay, borosilicate glass, aluminosilicate glass, or glass fibers.

[0031] The binder is not necessarily limited to a single component but instead may comprise a mixture of two or more binders, such as 0-15% bentonite and 85-100% laponite. In an embodiment of the invention, a binder mixture comprising 0-15 wt % bentonite and 85-100 wt % laponite is used in the construction of a catalytic burner.

[0032] The increased working temperatures of zeolite-based burners can also be achieved by the addition of a high thermal conductivity material, such as boron nitride (BN). The BN increases the thermal conductivity of the monolith and thus higher temperatures are achieved. A thermal conductor, as used herein, is any material which assists in the transfer of heat through the burner structure. In addition to boron nitride, thermal conductors include materials such as, without limitation, steel, stainless steel, transition metals, carbon nanofibers, carbon nanotubes, or diamond.

[0033] Additionally, the catalytic burner structure may contain additives that enhance the combustion of organic compounds. These additives include materials such as, without limitation, octahedral layered manganese oxide (OL-1), octachedral molecular sieve (OMS-1), manganese oxide, or perovskites.

[0034] An embodiment of the invention comprises about 15 wt % binder, about 84 wt % molecular sieve, and about 1 wt % thermal conductor.

[0035] In an embodiment of the invention, the catalyst which is embedded throughout the structure of the catalytic burner, is a metal catalyst comprising a single metal or a mixture of two or more metals. Examples of metals that are used as catalysts in embodiments of the invention include, without limitation, gold, manganese, cerium, cobalt, copper, lanthanum platinum, palladium, and rhodium and combination thereof. However, one of ordinarily skill in the art would recognize that any metal that enhances the combustion or oxidation of the fuels may be used as a catalyst in embodiments of the invention, including metals in Group VIII.

[0036] In certain embodiments of the invention, the dispersed catalyst is comprised of 1-100 wt % platinum and 0-99 wt % rhodium. In other embodiments of the invention, the catalyst comprises about 75 wt % platinum and about 25 wt % rhodium.

[0037] The catalytic burner systems of the invention present several advantages over existing burners. Firstly, the construction of the burner using zeolite or molecular sieve materials permits the sequestration of the catalyst in the pores of the molecular sieve. This allows placement of the catalyst in specific areas of the upper portion of the burner, and also permits the introduction of other metals into the pores. Secondly, the porosity of the molecular sieves facilitates the increased flow of fuel through the system. The walls of the pores of the molecular sieves are themselves extremely porous, unlike the pore walls of macroporous ceramic materials that have low porosity and prevent flow of fuel. Consequently, zeolite-based burners have a higher flow rate and flow volume. Since flow rate and flow volume together dictate how fast and how much fuel reach the catalyst, higher flow rates and volumes promote higher temperature of the catalyst. The ability of zeolites to selectively adsorb molecules allows for more control over the chemistry of the catalyst and the burner materials. These properties provide advantages in adapting the chemistry of the burners for future applications that include changes in fuel composition.

WORKING EXAMPLES

Example 1

Zeolite/Clay Composite Catalytic Burners

[0038] Typical zeolite/clay catalytic burners are composed of 85 wt % zeolite (NaX) and 15 wt % bentonite. To 8.5 g zeolite NaX, 1.5 g of bentonite is added. The solids are mixed vigorously and ground in a mortar and pestle to ensure complete mixing. Then, 5.5 ml of a 2 wt % polyvinyl alcohol (PVA) and water solution was added to the solids. After thorough mixing the solids were placed in a die and pressed at 5000 psig. The compressed pellet was then removed from the die and dried at 50° C. for 24 hours. The dried pellet was then placed in a tube furnace and heated to 850° C. for 6 hours. The hardened, formed pellet was then removed and shaped. After shaping, metal catalysts were absorbed into the composite form.

[0039] To prepare the catalysts, 30 mg of platinum(II) acetylacetonate and 10 mg of rhodium(II) acetate were

ground together in a mortar and pestle. The catalyst mixture was then dissolved in 5 ml acetone. The preformed zeolite composite burner was dipped into the catalyst solution and allowed to absorb the catalyst solution. This procedure was repeated as necessary to ensure complete coverage. The catalyst loaded composite was then heated at 500° C. under flowing air for 2 hours to decompose the metal salts. The temperature was then reduced to 250° C. and the composite was heated for 2 hours under flowing H_2 to reduce the metal. After cooling to room temperature the completed catalytic burner was removed.

Example 2

Zeolite/Clay/Boron Nitride (BN) Composite Catalytic Burners

[0040] Typical zeolite/clay/BN catalytic burners are composed of 77 wt % zeolite (NaX), 15 wt % bentonite, and 8 wt % BN. To 7.7 g zeolite NaX, 1.5 g of bentonite and 0.8 g BN is added. The solids are mixed vigorously and ground in a mortar and pestle to ensure complete mixing. Then, 5.5 ml of a 2 wt % polyvinyl alcohol (PVA) and water solution was added to the solids. After thorough mixing the solids were placed in a die and pressed at 5000 gpsi. The compressed pellet was then removed from the die and dried at 50° C. for 24 hours. The dried pellet was then placed in a tube furnace and heated to 850° C. for ~6 hours. The hardened, formed pellet was then removed and shaped. After shaping, metal catalysts were absorbed into the composite form.

[0041] To prepare the catalysts, 30 mg of platinum(II) acetylacetonate and 10 mg of rhodium(II) acetate were ground together in a mortar and pestle. The catalyst mixture was then dissolved in 5 ml acetone. The pre-formed zeolite composite burner was dipped into the catalyst solution and allowed to absorb the catalyst solution. This procedure was repeated as necessary to ensure complete coverage. The catalyst loaded composite was then heated at 500° C. under flowing air for 2 hours to decompose the metal salts. The temperature was then reduced to 250° C. and the composite was heated for 2 hours under flowing H_2 to reduce the metal. After cooling to room temperature the completed catalytic burner was removed.

Example 3

Zeolite/Glass Composite Catalytic Burners

[0042] Typical zeolite/glass catalytic burners are composed of 85 wt. % zeolite (ZSM-5, Si/Al=220) and 15 wt % borosilicate glass. To 8.5 g zeolite ZSM-5, 1.5 g of 270 mesh ground glass is added. The solids are mixed vigorously and ground in a mortar and pestle to ensure complete mixing. Then, 4.5 ml of a 2 wt % polyvinyl alcohol (PVA) and water solution was added to the solids. After thorough mixing the solids were poured into a mold and dried at 50° C. for 24 hours. The dried pellet was removed from the mold and placed in a tube furnace and heated to 1000° C. for ~1 hour. The hardened, formed pellet was then cooled to room temperature.

[0043] To prepare the catalysts, 30 mg of platinum(II) acetylacetonate and 10 mg of rhodium(II) acetate were ground together in a mortar and pestle. The catalyst mixture was then dissolved in 5 ml acetone. The pre-formed zeolite composite burner was dipped into the catalyst solution and allowed to absorb the catalyst solution. This procedure was repeated as necessary to ensure complete coverage. The catalyst loaded composite was then heated at 500° C. under flowing air for 2 hours to decompose the metal salts. The temperature was then reduced to 250° C. and the composite was heated for 2 hours under flowing H_2 to reduce the metal. After cooling to room temperature the completed catalytic burner was removed.

Example 4

Zeolite/Glass/BN Composite Catalytic Burners

[0044] Typical zeolite/glass/BN catalytic burners are composed of 84 wt. % zeolite (ZSM-5, Si/Al=220), 15 wt % borosilicate glass, and 1 wt % boron nitride. To 8.4 g zeolite ZSM-5, 1.5 g of 270 mesh ground glass, and 0.1 g BN is added. The solids are mixed vigorously and ground in a mortar and pestle to ensure complete mixing. Then, 4.5 ml of a 2 wt % polyvinyl alcohol (PVA) and water solution was added to the solids. After thorough mixing the solids were poured into a mold and dried at 50° C. for 24 hours. The dried pellet was removed from the mold and placed in a tube furnace and heated to 1000° C. for ~1 hour. The hardened, formed pellet was then cooled to room temperature.

[0045] To prepare the catalysts, 30 mg of platinum(II) acetylacetonate and 10 mg of rhodium(II) acetate were ground together in a mortar and pestle. The catalyst mixture was then dissolved in 5 ml acetone. The pre-formed zeolite composite burner was dipped into the catalyst solution and allowed to absorb the catalyst solution. This procedure was repeated as necessary to ensure complete coverage. The catalyst loaded composite was then heated at 500° C under flowing air for 2 hours to decompose the metal salts. The temperature was then reduced to 250° C. and the composite was heated for 2 hours under flowing H_2 to reduce the metal. After cooling to room temperature the completed catalytic burner was removed.

Example 5

Zeolite/Glass/Clay/BN Composite Catalytic Burners

[0046] Typical zeolite/glass/BN catalytic burners are composed of 82 wt. % zeolite (ZSM-5, Si/Al=220), 15 wt % borosilicate glass, 2 wt % bentonite, and 1 wt % boron nitride. To 10.1 g zeolite ZSM-5, 1.8 g of glass fibers, 0.27 g bentonite, and 0.14 g BN is added. The solids are mixed vigorously and ground in a mortar and pestle to ensure complete mixing. Then, 4.5 mL of a 2 wt % polyvinyl alcohol (PVA) and water solution was added to the solids. After thorough mixing the solids were poured into a mold and dried at 50° C. for 24 hours. The dried pellet was removed from the mold and placed in a furnace and heated to 1000° C. for ~1 hour. The hardened, formed pellet was then cooled to room temperature.

[0047] To prepare the catalysts, 30 mg of platinum(II) acetylacetonate and 10 mg of rhodium(II) acetate were ground together in a mortar and pestle. The catalyst mixture was then dissolved in 5 mL acetone. The pre-formed zeolite composite burner was dipped into the catalyst solution and allowed to absorb the catalyst solution. This procedure was repeated as necessary to ensure complete coverage. The catalyst loaded composite was then heated at 500° C. under

flowing air for 2 hours to decompose the metal salts. The temperature was then reduced to 250° C. and the composite was heated for 2 hours under flowing H_2 to reduce the metal. After cooling to room temperature the completed catalytic burner was removed.

Example 6

Zeolite Composite Catalytic Burner With Palladium

[0048] Typical zeolite/glass/BN catalytic burners are composed of 82 wt. % zeolite (ZSM-5, Si/Al=220), 15 wt % borosilicate glass, 2 wt % bentonite, and 1 wt % boron nitride. To 10.1 g zeolite ZSM-5, 1.8 g of glass fibers, 0.27 g bentonite, and 0.14 g BN is added. The solids are mixed vigorously and ground in a mortar and pestle to ensure complete mixing. Then, 4.5 ml of a 2 wt % polyvinyl alcohol (PVA) and water solution was added to the solids. After thorough mixing the solids were poured into a mold and dried at 50° C. for 24 hours. The dried pellet was removed from the mold and placed in a furnace and heated to 1000° C. for ~1 hour. The hardened, formed pellet was then cooled to room temperature.

[0049] To prepare the catalyst, 30 mg of palladium(II) acetate an was dissolved in 5 ml acetone. The pre-formed zeolite composite burner was dipped into the catalyst solution and allowed to absorb the catalyst solution. This procedure was repeated as necessary to ensure complete coverage. The catalyst loaded composite was then heated at 500° C. under flowing air for 2 hours to decompose the metal salts. The temperature was then reduced to 250° C. and the composite was heated for 2 hours under flowing H_2 to reduce the metal. After cooling to room temperature, the completed catalytic burner was removed.

1. A catalytic burner system comprising:

a burner comprising at least one molecular sieve, wherein said burner comprises an upper portion and a lower portion;

a catalyst, wherein said catalyst is dispersed within the upper portion of the burner;

a wick, wherein said wick comprises an upper portion and a lower portion, the upper portion of the wick being connected to the lower portion of the burner; and,

a reservoir, wherein said reservoir houses a liquid fuel that is contacted by the lower portion of the wick.

2. The burner system of claim 1, wherein the wick is removably connected to the burner.

3. The burner system of claim 1, wherein the wick is permanently connected to the burner.

4. The burner system of claim 1, wherein the concentration of the dispersed catalyst decreases in a gradient from the surface to the interior of the burner.

5. The burner system of claim 1, wherein said catalyst is a Group VIII metal.

6. The burner system of claim 1, wherein the catalyst is a metal selected from the group consisting of gold, manganese, cerium, cobalt, copper, lanthanum, platinum, palladium and rhodium.

7. The burner system of claim 1, wherein said burner comprises a binder that forms a rigid structure when heated.

8. The burner system of claim 7, wherein the binder is selected from the group consisting of bentonite, hectorite, laponite, montmorillonite, ball clay, kaolin, palygorskite (attapulgite), barasym SSM-100(synthetic mica-montmorillonite), ripidolite, rectorite, optigel SH (synthetic hectorite), illite, nontronite, illite-smectite, sepiolite, beidellite, cookeite, or generally any type of clay, borosilicate glass, aluminosilicate glass and glass fibers.

9. The burner system of claim 1, wherein said burner comprises a thermal conductor that facilitates the transfer of heat through the burner.

10. The burner system of claim 9, wherein the thermal conductor is selected from the group consisting of boron nitride, steel, stainless steel, transition metals, carbon nanofibers, carbon nanotubes and diamond.

11. The burner system of claim 1, wherein said burner comprises a combustion additive that enhances the combustion of the liquid fuel.

12. The burner system of claim 1, wherein said molecule sieve is a zeolite.

13. The burner system of claim 12, wherein said zeolite has a Si/Al ratio of greater than 60.

14. The burner system of claim 1, wherein said wick is made of a porous material.

15. The burner system of claim 14, wherein said porous material is a zeolite.

16. The burner system of claim 1, wherein said wick is a woven cloth wick.

17. A method for combusting a liquid fuel comprising,

providing a burner comprising at least one molecular sieve, wherein said burner has a first, upper portion and a second, lower portion;

providing a wick that is connected to the lower portion of the burner;

providing a catalyst that is dispersed within the upper portion of the burner;

providing a reservoir that contain liquid fuel;

contacting the wick with the liquid fuel;

transmitting the fuel from the reservoir to the burner through the wick; and,

igniting the catalyst with an ignition source.

18. The method of claim 17, wherein the catalyst is dispersed in a concentration gradient that decreases from the surface of the burner to the interior of the burner.

19. The method of claim 17, wherein said catalyst is a Group VIII metal.

20. The method of claim 17, wherein the catalyst is a metal selected from the group consisting of gold, manganese, cerium, cobalt, copper, lanthanum, platinum, palladium and rhodium.

21. The method of claim 17, wherein the burner comprises a binder that forms a rigid structure when heated.

22. The method of claim 17, wherein said burner comprises a thermal conductor that facilitates the transfer of heat through the burner.

23. The method of claim 17, wherein said burner comprises a combustion additive that enhances the combustion of the liquid fuel.

24. The method of claim 17, wherein said molecule sieve is a zeolite.

25. The method of claim 24, wherein said zeolite has a Si/Al ratio of greater than 60.

26. The method of claim 17, wherein said wick is made of a porous material.

27. The method of claim 26, wherein said porous material is a zeolite.

28. The method of claim 17, wherein said wick is a woven cloth wick.

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