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(54) Title: EXHAUST GAS PURIFYING CATALYST

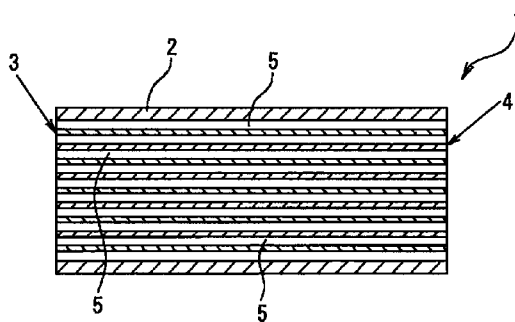


FIG. 1

(57) Abstract: An exhaust gas purifying catalyst includes two catalyst layers containing a fire resistant inorganic compound carrying a catalyst component in an exhaust gas passage of a base material provided with the exhaust gas passage penetrating through the base material from the exhaust gas introduction port side to discharge port side, wherein each catalyst layer is formed by supporting the catalyst component on a different fire resistant inorganic compound, a catalyst layer extended from the exhaust gas introduction port side to the exhaust gas discharge port side and a catalyst layer extended from the exhaust gas discharge port side to the exhaust gas introduction port side are formed such that the catalyst layers are overlapped on each other and the exhaust gas introduction port side is coated only with one of the catalyst layers and the exhaust gas discharge port side is coated only with the other.



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EXHAUST GAS PURIFYING CATALYST

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to Japanese Patent Application No. Tokugan 2010-178287, which was filed on August 9, 2010, and US Patent Application No. 13/075,420, filed March 30, 2011, the disclosures of which are incorporated by reference herein in their entirety for all purposes.

FIELD OF THE INVENTION

The present invention relates to an exhaust gas purifying catalyst used to purify the exhaust gas emitted from an internal combustion engine.

BACKGROUND OF THE INVENTION

An exhaust gas purifying catalyst is used to purify exhaust gas of harmful substances such as carbon monoxide (CO), unburned hydrocarbons (HC) and nitrogen oxides (NO_x) which are contained in the exhaust gas emitted from internal combustion engines such as automobile engines. In recent years, three-way catalysts have been more commonly utilized to eliminate CO, HC and NO_x at the same time by oxidation and reduction.

As the three-way catalyst, known catalysts include a honeycomb substrate with many exhaust gas passages penetrating through the substrate from the exhaust gas introduction port side to discharge port side. These catalysts have a catalyst layer formed in the exhaust gas passages which supports precious metals, such as Pt and Pd, which are superior in resistance to oxidation, and precious metals such as Rh, which are superior in resistance to reduction, either individually or in combinations of two or more, on a fire resistant inorganic compound such as alumina and ceria-zirconia. A purifying catalyst has been proposed as part of a two-layered catalyst structure to improve, for example, heat resistance and to thereby improve purifying ability. For example, Japanese Patent Application Laid-Open No. 2001-205051 relates to a purifying catalyst provided with a first and a second catalyst layer in an exhaust gas passage, wherein a part provided with only the first catalyst layer is made to exist and also, a two-layered catalyst part where the first and second catalyst layers are laminated on each other is formed on the exhaust gas introduction port side and/or exhaust gas discharge port side. Also, JP-A No. 2006-75724 describes a purifying catalyst having a structure in which a coat layer of a support made of a porous oxide of alumina, cerium-zirconium or the like is formed on the entire surface of an exhaust gas passage. Then, the whole coat layer is made to support Rh, a part of the coat layer is made to support Pt, a coexisting zone where Rh and Pt are supported together is formed in a region extending from the end surface of the exhaust gas introduction port side to 4/10 or less of the whole length of the exhaust gas passage, and a zone where only Rh is supported is formed in the downstream side of the above Rh/Pt zone.

SUMMARY OF THE INVENTION

In the case of coating the entire exhaust gas passage of the base material with the catalyst layer, two steps are required in order to uniformly coat the catalyst layer according to an embodiment of the invention. A first step involves coating a part extending from the exhaust gas introduction port side or discharge port side to 50% of the whole length of the exhaust gas passage. A second step involves coating a part extending from the exhaust gas discharge port side or introduction port side to 50% of the whole length of the exhaust gas passage. JP-A No. 2001-205051 describes a purifying device in which after the entire exhaust gas passage is coated with the first catalyst layer, the second catalyst layer is disposed in a part of the exhaust gas discharge port side to thereby form a part where the first and second catalyst layers are laminated on each other in the exhaust gas introduction port side and/or discharge port side. Accordingly, such a device requires two steps to form the first catalyst layer and one or two coating steps to form the second catalyst layer. Similarly, JP-A No. 2006-75724 describes a purifying device which has a first catalyst layer formed on the whole exhaust gas passage and a second catalyst layer overlapped with the first catalyst layer in a part of the exhaust gas introduction port side. Such a device requires two coating steps to form the first catalyst layer and one coating step to form the second catalyst layer. Therefore, a total of three and four coating steps is required to form a catalyst layer having a two-layered structure (i.e., a first and a second catalyst layer). However, the necessity of performing three and four coating steps to form the first and second catalyst layers results in very high costs and such methods are therefore inefficient. Also, because the zone where the first and second catalyst layers are overlapped increases the thickness of the catalyst layer, the opening areas of the exhaust gas introduction port and discharge port are narrowed. This causes inferior flow of exhaust gas and there is, therefore, a fear as to a low engine output because of a rise of backpressure of the catalyst. Also, because the heat capacity of the catalyst at the exhaust gas introduction port is increased, so that the warming ability of the catalyst is lowered, there is a fear as to the retardation of early activation of the catalyst. The inventors of the present invention have made earnest studies to solve the above conventional problems, and as a result, found that the above problems can be solved by providing a catalyst layer having a structure including a catalyst layer extended from the exhaust gas introduction port side toward the exhaust gas discharge port side and a catalyst layer extended from the exhaust gas discharge port side toward the exhaust gas introduction port side, wherein a part where the catalyst layers are overlapped on each other is formed and the exhaust gas introduction port side is coated only with one of the catalyst layers and the exhaust gas discharge port side is coated only with the other, to complete the present invention.

Accordingly, in a first embodiment, the present invention relates to: An exhaust gas purifying catalyst including two catalyst layers containing a fire resistant inorganic compound carrying a catalyst component in an exhaust gas passage of a base material provided with the exhaust gas passage penetrating through the base material from the exhaust gas introduction port side to discharge port side, wherein each catalyst layer is formed by supporting the catalyst component on a different fire resistant inorganic compound, a catalyst layer extended from the exhaust gas introduction port side to the exhaust gas discharge port side and a catalyst layer extended from the exhaust gas discharge port side to the exhaust gas introduction port side are formed such that the catalyst layers are overlapped on each other and the exhaust gas introduction port side is coated only with one of the catalyst layers and the exhaust gas discharge port side is coated only with the other.

In a second embodiment, the present invention relates to an exhaust gas purifying catalyst according to the first embodiment described above, wherein the catalyst layer extended from the exhaust gas introduction port side to the exhaust gas discharge port side has a length of 40% or more to less than 100% of the length of the exhaust gas passage and the catalyst layer extended from the exhaust gas discharge port side to the exhaust gas introduction port side has a length of 40% or more to less than 100% of the length of the exhaust gas passage, the both catalyst layers being partly overlapped on each other.

In a third embodiment, the present invention relates to an exhaust gas purifying catalyst according to the second embodiment above, wherein after a first catalyst layer extended from the exhaust gas introduction port side to discharge port side of the exhaust gas passage is formed, a second catalyst layer extended from the exhaust gas discharge port side to introduction port side of the exhaust gas passage is formed.

In a fourth embodiment, the present invention relates to an exhaust gas purifying catalyst according to the second embodiment described above, wherein after a first catalyst layer extended from the exhaust gas discharge port side to introduction port side of the exhaust gas passage is formed, a second catalyst layer extended from the exhaust gas introduction port side to discharge port side of the exhaust gas passage is formed.

In a fifth embodiment, the present invention relates to an exhaust gas purifying catalyst according to the third or fourth embodiments described above, wherein the first catalyst layer contains a precious metal selected from platinum, palladium, rhodium, and palladium/platinum as the catalyst component and the second catalyst layer contains a precious metal selected from the group of platinum, palladium, rhodium, rhodium/platinum and rhodium/palladium as the catalyst component.

In a sixth embodiment, the present invention relates to an exhaust gas purifying catalyst according to the third or fourth embodiments described above, wherein the first catalyst layer contains a precious metal selected from platinum, palladium, rhodium, rhodium/platinum and rhodium/palladium as the catalyst component and the second catalyst layer contains a precious metal selected from the group of platinum, palladium, rhodium and palladium/platinum as the catalyst component.

Accordingly, the embodiments of the present invention only require two coating steps: the coating of one catalyst layer formed on a part of the exhaust gas passage only from the exhaust gas introduction port side and the other catalyst layer formed on a part of the exhaust gas passage from the exhaust gas discharge port side. The embodiments of the present invention make it possible to form the catalyst layer more efficiently than the conventional catalyst layer provided with two catalyst layers overlapped on each other and, therefore, the exhaust gas purifying catalyst of the present invention can be produced at a lower cost than conventional purifying catalysts though it is provided with two catalyst layers. Since only single catalyst layers are formed on each of the exhaust gas introduction port side and discharge port side, the opening areas of the exhaust gas introduction port and discharge port are wider, bringing about a better gas flow which limits a rise in the backpressure of the catalyst. This makes it possible to further improve the output power of the engine as compared with the case of forming zones where the catalyst layers are overlapped at the exhaust gas introduction port side and discharge port side. Moreover, unlike the case of forming the zone where catalyst layers are overlapped on the exhaust gas introduction port side, the heat capacity of the catalyst is not raised, so that the warming ability (easy warming tendency) of the catalyst is improved, thereby making possible to promote the early activation of the catalyst. Particularly, when the first catalyst layer and the second catalyst layer are formed such that each layer is extended to the length of 40% or more to less than 100% of the length of the exhaust gas passage, a part where the first catalyst layer and the second catalyst layer each having a sufficient length are overlapped is formed in the exhaust gas passage and therefore, the catalyst of the present invention has, for example, the effect of producing the same or higher purifying effect than the conventional catalysts provided with two catalyst layers.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal sectional view of an exhaust gas purifying catalyst according to the present invention along the direction of an exhaust gas passage;

FIG. 2 is an enlarged sectional view of an exhaust gas passage; and

FIG. 3 is an enlarged sectional view of an exhaust gas passage in another example of an exhaust gas purifying catalyst.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, an exhaust gas purifying catalyst according to the present invention will be explained with reference to the drawings.

FIG. 1 shows an example of an exhaust gas purifying catalyst 1 of the present invention. Reference numeral 2 represents a cylinder-like base material, which is provided with a plurality of exhaust gas passages 5 which penetrate through the base material from an exhaust gas introduction port 3 to the side of an exhaust gas discharge port 4. As the base material 2, a material made of cordierite, metal, silicon carbide, silicon nitride or aluminum nitride, for example, may be used.

Catalyst layers 6 and 7 containing a fire resistant inorganic compound carrying a catalyst component are formed in each exhaust gas passage 5 of the base material 2, as shown in FIGS. 2 and 3. As shown in FIG. 2, the exhaust gas purifying catalyst of the present invention has a structure in which one of the catalyst layers 6 is formed extending from the exhaust gas introduction port 3 side toward the exhaust gas discharge port 4 side, the other catalyst layer 7 is formed extending from the exhaust gas discharge port 4 side toward the exhaust gas introduction port 3 side, and the catalyst layers 6 and 7 are formed such that there is a part where both layers are overlapped on each other. FIG. 3, shows another embodiment of the present invention in which one of the catalyst layers 6 is formed extending from the exhaust gas discharge port 4 side toward the exhaust gas introduction port 3 side, the other catalyst layer 7 is formed extending from the exhaust gas introduction port 3 side toward the exhaust gas discharge port 4 side, and the catalyst layers 6 and 7 are formed such that there is a part where both layers are overlapped on each other. In both of these embodiments, the exhaust gas introduction port 3 side and the exhaust gas discharge port 4 side are each constituted of a single catalyst layer 6 or 7.

In the exhaust gas purifying catalyst of the present invention, the catalyst layers 6 and 7 are each preferably formed in a range from 40% or more to less than 100% and more preferably 45% or more and 90% or less of the length of the exhaust gas passage to develop excellent exhaust gas purifying effect without impairing the flow of gas at the exhaust gas introduction port 3 and exhaust gas discharge port 4.

FIG. 2 shows an example in which after the first catalyst layer 6 is formed in such a manner that it is extended from the exhaust gas introduction port 3 side toward the exhaust gas discharge port 4 side to the length of 40% or more and less than 100% of the length of the exhaust gas passage 5, the second catalyst layer 7 is formed in such a manner that it is extended from the exhaust gas discharge port 4 side toward the exhaust gas introduction port 3 side to the length of 40% or more and less than 100% of the length of the exhaust gas passage 5. The first catalyst layer 6 and the second catalyst layer 7 are formed such that a part A where the both are overlapped on each other is provided.

However, since each of the catalyst layers 6 and 7 is disposed such that it is extended to the length of less than 100% of the length of the exhaust gas passage 5, the exhaust gas introduction port 3 side and the exhaust gas discharge port 4 side are each constituted of a single catalyst layer. In an example shown in FIG. 2, a part B constituted only of the first catalyst layer 6 is formed on the exhaust gas introduction port 3 side of the exhaust gas passage 5 and a part C constituted only of the second catalyst layer 7 is formed on the exhaust gas discharge port 4 side of the exhaust gas passage 5.

Also, FIG. 3 shows an example in which after the first catalyst layer 6 is formed in such a manner that it is extended from the exhaust gas discharge port 4 side toward the exhaust gas introduction port 3 side to the length of 40% or more and less than 100% of the length of the exhaust gas passage 5, the second catalyst layer 7 is formed in such a manner that it is extended from the exhaust gas introduction port 3 side toward the exhaust gas discharge port 4 side to the length of 40% or more and less than 100% of the length of the exhaust gas passage 5. In the example shown in FIG. 3, a part C constituted only of the second catalyst layer 7 is formed on the exhaust gas introduction port 3 side of the exhaust gas passage 5 and a part B constituted only of the first catalyst layer 6 is formed on the exhaust gas discharge port 4 side of the exhaust gas passage 5.

In the purifying catalyst of the present invention, it is only required that each of the catalyst layers 6 and 7 be formed such that it is extended to the length of 40% or more and less than 100% of the exhaust gas passage 5. However, in at least one embodiment the catalyst layers are formed such that there is a part A where the catalyst layers 6 and 7 are overlapped. Therefore, when, for example, one of the catalyst layers 6 and 7 is designed to have a length of 40% of the length of the exhaust gas passage 5, it is necessary that the other be disposed such that it is extended to the length exceeding 60% of the length of the exhaust gas passage 5.

In the present invention, the catalyst layers 6 and 7 are preferably disposed such that the part A where the catalyst layers 6 and 7 are overlapped on each other has a length of, preferably 20% to 90% and more preferably 30% to 80% of the exhaust gas passage 5. Also, the zone B constituted only of the catalyst layer 6 and the zone C constituted only of the catalyst layer 7 are preferably disposed such that the ratio of B : C = 1 : 1 to 1 : 5. Also, each of the catalyst layers 6 and 7 is preferably disposed such that its length is 70% or more and 95% or less of the exhaust gas passage 5.

The catalyst layers 6 and 7 may be respectively formed using, for example, a method in which a slurry containing a catalyst component and a fire resistant inorganic compound carrying the catalyst component is applied to the inside of the exhaust gas passage 5 of the base material 2 by coating, followed by drying and calcining. Examples of the catalyst component include base metals such as nickel, copper, manganese, iron, cobalt

and zinc, and precious metals such as gold, silver, ruthenium, rhodium, palladium, osmium, iridium and platinum. Among these metals, a base metal such as nickel and precious metals are preferable and precious metals are more preferable. The catalyst components may be used in combinations of two or more, and, for example, two or more types of precious metals such as palladium and platinum or rhodium and platinum may be combined prior to use. Also, when a precious metal is used as the catalyst component, it is preferable to use a base metal nickel because the use of nickel limits the production of hydrogen sulfide.

Examples of the fire resistant inorganic compound include single types or plural types of alumina, silica alumina, zeolite, titanium oxide, silica, ceria and zirconia, and further, composite oxides of plural types of these compounds. The fire resistant inorganic compounds are used in a powder state and in this case, those having an average particle diameter of 2 to 10 μm are preferable. In the present invention, fire resistant inorganic compounds differing in composition or type are used for the catalyst layers 6 and 7. The term "differing in composition" means that when the fire resistant inorganic compound used for the catalyst layers 6 and 7 is a mixture of plural types such as alumina and ceria-zirconia composite oxides, the ratios of the same type of fire resistant inorganic compound to be mixed in the catalyst layers 6 and 7 are different from each other. Alternatively, the term means that even in the case of the same type of ceria-zirconia composite oxide, the ratios of ceria to zirconia are different from each other. The term "differing in type" means that even if the fire resistant inorganic compounds used in the catalyst layers 6 and 7 are alumina having the same composition, fire resistant inorganic compounds differing in crystal form like the case of γ -alumina and θ -alumina are used. In the present invention, as the fire resistant inorganic compound constituting the first catalyst layer 6, a mixture of a ceria-zirconia composite oxide (ratio of ceria: 40 to 70% by weight) and γ -alumina or a mixture of alumina and a ceria-zirconia composite oxide (ratio of alumina: 25 to 80% by weight) is preferable. Also, as the fire resistant inorganic compound constituting the second catalyst layer 7, a mixture of a ceria-zirconia composite oxide (ratio of zirconia: 70 to 95% by weight) and γ -alumina or a mixture of alumina and a ceria-zirconia composite oxide (ratio of ceria-zirconia composite oxide: 50 to 80% by weight) is preferable.

The slurry containing the catalyst component can be prepared by dispersing a fire resistant inorganic compound in an aqueous solution of a salt of a base metal or a salt of a precious metal. Besides the catalyst component and fire resistant inorganic compound, alkali metals, alkali earth metals or rare earth elements capable of improving the heat resistance of the fire resistant inorganic compound may be formulated in the slurry according to the need. Examples of the alkali metal include potassium compounds,

cesium compounds, examples of the alkali earth metal include calcium compounds, barium compounds and strontium compounds, and examples of the rare earth metals include lanthanum oxide, praseodymium oxide and neodymium oxide.

Examples of a method of coating the exhaust gas passage 5 by using the above slurry include a method in which the base material 2 is dipped in the slurry and a method in which the slurry is cast in the base material 2. For example, the exhaust gas purifying catalyst which is shown in FIG. 2 and prepared by forming the first catalyst layer 6 extending from the exhaust gas introduction port 3 side toward the exhaust gas discharge port 4 side and then by forming the second catalyst layer 7 extending from the exhaust gas discharge port 4 side toward the exhaust gas introduction port 3 side can be obtained by dipping the base material 2 in a first catalyst layer forming slurry from the exhaust gas introduction port 3 side in such a manner that 40% or more and less than 100% of the length of the exhaust gas passage 5 is immersed in the first catalyst layer forming slurry, followed by drying and calcining to form the first catalyst layer 6, and then, by dipping the base material 2 in a second catalyst layer forming slurry from the exhaust gas discharge port 4 side in such a manner that 40% or more and less than 100% of the length of the exhaust gas passage 5 is immersed in the second catalyst layer forming slurry, followed by drying and calcining to form the second catalyst layer 7. Also, the exhaust gas purifying catalyst which is shown in FIG. 3 and prepared by forming the first catalyst layer 6 extending from the exhaust gas discharge port 4 side toward the exhaust gas introduction port 3 side and then by forming the second catalyst layer 7 extending from the exhaust gas introduction port 3 side toward the exhaust gas discharge port 4 side can be obtained by dipping the base material 2 in a first catalyst layer forming slurry from the exhaust gas discharge port 4 side in such a manner that 40% or more and less than 100% of the length of the exhaust gas passage 5 is immersed in the first catalyst layer forming slurry, followed by drying and calcining to form the first catalyst layer 6, and then, by dipping the base material 2 in a second catalyst layer forming slurry from the exhaust gas introduction port 3 side in such a manner that 40% or more and less than 100% of the length of the exhaust gas passage 5 is immersed in the second catalyst layer forming slurry, followed by drying and calcining to form the second catalyst layer 7.

The exhaust gas purifying catalyst of the present invention exhibits particularly excellent three-way catalyst characteristics and is improved in durability in the case where the first catalyst layer 6 contains any one of platinum, palladium, rhodium, rhodium/platinum and rhodium/palladium as the catalyst component and the second catalyst layer 7 contains any one of platinum, palladium, rhodium and palladium/platinum as the catalyst component, or in the case where the first catalyst layer 6 contains any one of platinum, palladium, rhodium and palladium/platinum as the catalyst component and

the second catalyst layer 7 contains any one of platinum, palladium, rhodium, rhodium/platinum and rhodium/palladium as the catalyst component, showing that these cases are desirable. The first catalyst layer 6 and the second catalyst layer 7 may contain either the same or different catalyst components and also, even in the case of containing the same catalyst component, different catalyst activities are developed in different catalyst layers because the fire resistant inorganic compounds carrying the catalyst components are different from each other. Also, the first catalyst layer 6 and the second catalyst layer 7 contain different fire resistant inorganic compounds, ensuring that more excellent three-way catalyst characteristics are developed and also, the catalyst is improved in durability.

EXAMPLES

Hereinafter, the present invention will be explained in more detail by way of examples.

Example 1

10 parts by weight of a γ -alumina powder, 16 parts by weight of a ceria-zirconia composite oxide (content of ceria: 65% by weight), 2.1 parts by weight of barium hydroxide and a palladium nitrate solution were added to 30 parts by weight of water and the mixture was stirred at a high speed for 30 minutes in the air to prepare a first catalyst layer forming slurry A. 4 parts by weight of a γ -alumina powder, 12 parts by weight of a ceria-zirconia composite oxide (content of ceria: 35% by weight), a platinum nitrate solution and a rhodium nitrate solution were added to 40 parts by weight of water and the mixture was stirred at a high speed for 30 minutes in the air to prepare a second catalyst layer forming slurry B.

The above slurry A was applied to a part extending to the length of 80% of the length of an exhaust gas passage from the end of the exhaust gas introduction port side toward exhaust gas discharge port side of a cordierite honeycomb base material (volume: 0.875 L) and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a first catalyst layer having a structure in which palladium was supported as a catalyst component to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide.

Then, the above slurry B was applied to a part extending to the length of 80% of the length of the exhaust gas passage from the end of the exhaust gas discharge port side toward exhaust gas introduction port side of the honeycomb base material formed with the first catalyst layer and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a second catalyst layer having a structure in which platinum and rhodium were supported as catalyst components to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide, to thereby obtain an exhaust

gas purifying catalyst. The amount of the supported catalyst of the obtained exhaust gas purifying catalyst per 1 L of the honeycomb base material was as follows: palladium in the first catalyst layer was 0.75 g and platinum and rhodium in the second catalyst layer were 0.75 g and 0.25 g respectively.

Comparative Example 1

The same slurry A that was used in Example 1 above was applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust gas introduction port side of the same honeycomb base material, and then, applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust gas discharge port side, followed by calcining at 500°C for 1 hour in the air atmosphere to thereby form a first catalyst layer carrying palladium.

Then, the same slurry B that was used in Example 1 was applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust gas introduction port side of the honeycomb base material formed with the first catalyst layer, and then applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust gas discharge port side, and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a second catalyst layer carrying platinum and rhodium, to thereby obtain an exhaust gas purifying catalyst. The amount of the supported catalyst of the obtained exhaust gas purifying catalyst per 1 L of the honeycomb base material was as follows: palladium in the first catalyst layer was 0.75 g and platinum and rhodium in the second catalyst layer were 0.75 g and 0.25 g respectively.

The purifying performances of the above Example 1 and Comparative Example 1 were evaluated by the following 50% purification temperature and LA #4 mode (actual car exhaust gas mode) purification performance to the U.S.A. The results of the 50% purification temperature are shown in Table 1 and the results of the LA #4 mode purification performance to the U.S.A are shown in Table 2.

50% purification temperature.

The exhaust gas purifying catalyst was put in a catalyst package can, which was then installed in the exhaust system of a 4000 cc gasoline engine. Regular gasoline was used as the fuel and the air/fuel ratio (A/F) of exhaust gas passing through the catalyst was varied on a 60-sec cycle: stoic (A/F = 14.5): 48 sec, rich (A/F = 12.5): 6 sec and lean (A/F = 30): 6 sec. The temperature in the catalyst bed was 1000°C and the catalyst was allowed to stand for 100 hours. After that, the exhaust gas catalyst was taken out of the catalyst package can and put in a cylinder having a diameter of 15 cm and a length of 40 cm. Then, the cylinder was attached to the engine bench mounted with a 2400 cc gasoline engine. The exhaust gas temperature was raised at a rate of 30°C/minutes from 200°C to 400°C through a heat exchanger while the engine was run with keeping the theoretical

air/fuel ratio in the exhaust gas composition, during which each ratio of purification of hydrocarbon (HC), carbon monoxide (CO) and nitrogen oxide (NO_x) was measured continuously, to calculate each temperature (50% purification temperature) at which 50% of each of the HC, CO and NO_x components was purified. The lower the 50% purification temperature is, the more excellent the catalyst is shown to be.

LA #4 mode purification performance to the U.S.A.

The exhaust gas purifying catalyst was put in a catalyst package can, which was then installed in the exhaust system of a 4000 cc gasoline engine. Regular gasoline was used as the fuel and the air/fuel ratio (A/F) of exhaust gas passing through the catalyst was varied on a 60-sec cycle: stoic (A/F = 14.5): 48 sec, rich (A/F = 12.5): 6 sec and lean (A/F = 30): 6 sec. The temperature in the catalyst bed was 1000°C and the catalyst was allowed to stand for 100 hours. After that, the exhaust gas catalyst was transferred to a separate catalyst package can, which was then placed right under a 2400 cc gasoline engine and Phase-2 gasoline was burned to evaluate the ability to purify non-methane hydrocarbons (NMHC), carbon monoxide (CO) and nitrogen oxide (NO_x) according to the LA #4 mode purification performance to the U.S.A. For the evaluation, a tester (trade name: MEXA 9000, manufactured by Horiba, Ltd.) was used. The smaller the value is, the more excellent the catalyst is shown to be.

[Table 1]

	50% purification temperature (°C)		
	HC	CO	NO _x
Example 1	373	375	377
Comparative Example 1	374	375	378
Example 2	348	348	348
Comparative Example 2	355	357	357
Example 3	330	330	330
Example 4	326	326	326
Example 5	325	321	325
Comparative Example 3	335	335	337
Example 6	321	317	317
Comparative Example 4	327	327	327

[Table 2]

	LA #4 mode purification performance (Total emission, g/mile)		
	NMHC	CO	NO _x
Example 1	0.025	0.24	0.069
Comparative Example 1	0.026	0.26	0.070
Example 2	0.024	0.27	0.051
Comparative Example 2	0.027	0.28	0.060
Example 3	0.024	0.21	0.044
Example 4	0.022	0.20	0.046
Example 5	0.023	0.20	0.042
Comparative Example 3	0.025	0.23	0.047
Example 6	0.019	0.24	0.038
Comparative Example 4	0.020	0.33	0.039

Example 2

10 parts by weight of a γ -alumina powder, 16 parts by weight of a ceria-zirconia composite oxide (content of ceria: 65% by weight), 2.1 parts by weight of barium hydroxide and a palladium nitrate solution were added to 30 parts by weight of water and the mixture was stirred at a high speed for 30 minutes in the air to prepare a first catalyst layer forming slurry A. Also, 4 parts by weight of a γ -alumina powder, 12 parts by weight of a ceria-zirconia composite oxide (content of ceria: 35% by weight), a platinum nitrate solution and a rhodium nitrate solution were added to 40 parts by weight of water and the mixture was stirred at a high speed for 30 minutes in the air to prepare a second catalyst layer forming slurry B.

The above slurry A was applied to a part extending to the length of 90% of the length of an exhaust gas passage from the end of the exhaust gas discharge port side toward exhaust gas introduction port side of a honeycomb base material which was the same one as that of Example 1 and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a first catalyst layer having a structure in which palladium was supported as a catalyst component to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide.

Then, the above slurry B was applied to a part extending to the length of 90% of the length of the exhaust gas passage from the end of the exhaust gas introduction port side toward exhaust gas discharge port side of the honeycomb base material formed with the first catalyst layer and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a second catalyst layer having a structure in which platinum and rhodium were supported as catalyst components to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide, to thereby obtain an exhaust gas purifying catalyst. The amount of the supported catalyst of the obtained exhaust gas purifying catalyst per 1 L of the honeycomb base material was as follows: palladium in the first catalyst layer was 0.75 g and platinum and rhodium in the second catalyst layer were 0.75 g and 0.30 g respectively.

Comparative Example 2

The same slurry A that was used in Example 2 was applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust gas introduction port side of the same honeycomb base material, and then, applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust gas discharge port side, followed by calcining at 500°C for 1 hour in the air atmosphere to thereby form a first catalyst layer carrying palladium.

Then, the same slurry B that was used in Example 1 was applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust

gas introduction port side of the honeycomb base material formed with the first catalyst layer, then the slurry B was applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust gas discharge port side, and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a second catalyst layer carrying platinum and rhodium, to thereby obtain an exhaust gas purifying catalyst. The amount of the supported catalyst of the obtained exhaust gas purifying catalyst per 1 L of the honeycomb base material was as follows: palladium in the first catalyst layer was 0.75 g and platinum and rhodium in the second catalyst layer were 0.75 g and 0.30 g respectively.

The purifying performances of the exhaust gas purifying catalysts of Example 2 and Comparative Example 2 were evaluated in the same manner as in Example 1. The results of the 50% purification temperature are shown in Table 1 and the results of the LA #4 mode purification performance to the U.S.A are shown in Table 2.

Example 3

12 parts by weight of a γ -alumina powder, 8 parts by weight of a ceria-zirconia composite oxide (content of ceria: 65% by weight), 2.1 parts by weight of barium hydroxide and a palladium nitrate solution were added to 25 parts by weight of water and the mixture was stirred at a high speed for 30 minutes in the air to prepare a first catalyst layer forming slurry A. Also, 4 parts by weight of a γ -alumina powder, 12 parts by weight of a ceria-zirconia composite oxide (content of ceria: 5% by weight) and a rhodium nitrate solution were added to 40 parts by weight of water and the mixture was stirred at a high speed for 30 minutes in the air to prepare a second catalyst layer forming slurry B.

The above slurry A was applied to a part extending to the length of 90% of the length of an exhaust gas passage from the end of the exhaust gas discharge port side toward exhaust gas introduction port side of a honeycomb base material which was the same one as that of Example 1 and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a first catalyst layer having a structure in which palladium was supported as a catalyst component to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide.

Then, the above slurry B was applied to a part extending to the length of 90% of the length of the exhaust gas passage from the end of the exhaust gas introduction port side toward exhaust gas discharge port side of the honeycomb base material formed with the first catalyst layer and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a second catalyst layer having a structure in which rhodium was supported as a catalyst component to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide, to thereby obtain an exhaust gas purifying catalyst. The amount of the supported catalyst of the obtained exhaust gas purifying

catalyst per 1 L of the honeycomb base material was as follows: palladium in the first catalyst layer was 1.75 g and rhodium in the second catalyst layer was 0.15 g.

Example 4

The same slurry A that was used in Example 3 was applied to a part extending to the length of 90% of the length of an exhaust gas passage from the end of the exhaust gas discharge port side toward exhaust gas introduction port side of a honeycomb base material which was the same one as that of Example 1 and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a first catalyst layer having a structure in which palladium was supported as a catalyst component to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide.

Then, the same slurry B that was used in Example 3 was applied to a part extending to the length of 70% of the length of the exhaust gas passage from the end of the exhaust gas introduction port side toward exhaust gas discharge port side of the honeycomb base material formed with the first catalyst layer and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a second catalyst layer having a structure in which rhodium was supported as a catalyst component to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide, to thereby obtain an exhaust gas purifying catalyst. The amount of the supported catalyst of the obtained exhaust gas purifying catalyst per 1 L of the honeycomb base material was as follows: palladium in the first catalyst layer was 1.75 g and rhodium in the second catalyst layer was 0.15 g.

Example 5

The same slurry A that was used in Example 3 was applied to a part extending to the length of 70% of the length of an exhaust gas passage from the end of the exhaust gas discharge port side toward exhaust gas introduction port side of a honeycomb base material which was the same one as that of Example 1 and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a first catalyst layer having a structure in which palladium was supported as a catalyst component to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide.

Then, the same slurry B that was used in Example 3 was applied to a part extending to the length of 90% of the length of the exhaust gas passage from the end of the exhaust gas introduction port side toward exhaust gas discharge port side of the honeycomb base material formed with the first catalyst layer and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a second catalyst layer having a structure in which rhodium was supported as a catalyst component to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide, to thereby obtain an exhaust gas purifying catalyst. The amount of the supported catalyst of

the obtained exhaust gas purifying catalyst per 1 L of the honeycomb base material was as follows: palladium in the first catalyst layer was 1.75 g and rhodium in the second catalyst layer was 0.15 g.

Comparative Example 3

The same slurry A that was used in Example 3 was applied to a part extending to the length of 50% of the length of an exhaust gas passage from the exhaust gas introduction port side of a honeycomb base material which was the same one as that of Example 1, then, applied to a part extending to the length of 50% of the length of an exhaust gas passage from the exhaust gas discharge port side, and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a first catalyst layer carrying palladium.

Then, the same slurry B that was used in Example 3 was applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust gas introduction port side of the honeycomb base material formed with the first catalyst layer, then, applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust gas discharge port side and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a second catalyst layer carrying rhodium, to thereby obtain an exhaust gas purifying catalyst. The amount of the supported catalyst of the obtained exhaust gas purifying catalyst per 1 L of the honeycomb base material was as follows: palladium in the first catalyst layer was 1.75 g and rhodium in the second catalyst layer was 0.15 g.

The purifying performances of the exhaust gas purifying catalysts of Examples 3 to 5 and Comparative Example 3 were evaluated in the same manner as in Example 1. The results of the 50% purification temperature are shown in Table 1 and the results of the LA #4 mode purification performance to the U.S.A are shown in Table 2.

Example 6

12 parts by weight of a γ -alumina powder, 8 parts by weight of a ceria-zirconia composite oxide (content of ceria: 45% by weight), 2.1 parts by weight of barium hydroxide and a palladium nitrate solution were added to 25 parts by weight of water and the mixture was stirred at a high speed for 30 minutes in the air to prepare a first catalyst layer forming slurry A. Also, 4 parts by weight of a γ -alumina powder, 12 parts by weight of a ceria-zirconia composite oxide (content of ceria: 5% by weight) and a rhodium nitrate solution were added to 40 parts by weight of water and the mixture was stirred at a high speed for 30 minutes in the air to prepare a second catalyst layer forming slurry B.

The above slurry A was applied to a part extending to the length of 80% of the length of an exhaust gas passage from the end of the exhaust gas introduction port side toward exhaust gas discharge port side of a honeycomb base material which was the same one as that of Example 1 and then calcined at 500°C for 1 hour in the air atmosphere to

thereby form a first catalyst layer having a structure in which palladium was supported as a catalyst component to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide.

Then, the above slurry B was applied to a part extending to the length of 80% of the length of the exhaust gas passage from the end of the exhaust gas discharge port side toward exhaust gas introduction port side of the honeycomb base material formed with the first catalyst layer and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a second catalyst layer having a structure in which rhodium was supported as a catalyst component to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide, to thereby obtain an exhaust gas purifying catalyst. The amount of the supported catalyst of the obtained exhaust gas purifying catalyst per 1 L of the honeycomb base material was as follows: palladium in the first catalyst layer was 1.75 g and rhodium in the second catalyst layer was 0.15 g.

Comparative Example 4

The same slurry A that was used in Example 6 was applied to a part extending to the length of 50% of the length of an exhaust gas passage from the exhaust gas introduction port side of a honeycomb base material which was the same one as that of Example 1, then, applied to a part extending to the length of 50% of the length of an exhaust gas passage from the exhaust gas discharge port side, and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a first catalyst layer carrying palladium.

Then, the same slurry B that was used in Example 3 was applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust gas introduction port side of the honeycomb base material formed with the first catalyst layer, then, applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust gas discharge port side and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a second catalyst layer carrying rhodium, to thereby obtain an exhaust gas purifying catalyst. The amount of the supported catalyst of the obtained exhaust gas purifying catalyst per 1 L of the honeycomb base material was as follows: palladium in the first catalyst layer was 1.75 g and rhodium in the second catalyst layer was 0.15 g.

The purifying performances of the exhaust gas purifying catalysts of Example 6 and Comparative Example 4 were evaluated in the same manner as in Example 1. The results of the 50% purification temperature are shown in Table 1 and the results of the LA #4 mode purification performance to the U.S.A are shown in Table 2.

Example 7

3.5 parts by weight of a γ -alumina powder, 9 parts by weight of a ceria-zirconia composite oxide (content of ceria: 58% by weight), 2.1 parts by weight of barium

hydroxide and a palladium nitrate solution were added to 15 parts by weight of water and the mixture was stirred at a high speed for 30 minutes in the air to prepare a first catalyst layer forming slurry A. Also, 4 parts by weight of a γ -alumina powder, 12 parts by weight of a ceria-zirconia composite oxide (content of ceria: 20% by weight), a platinum nitrate solution and a rhodium nitrate solution were added to 40 parts by weight of water and the mixture was stirred at a high speed for 30 minutes in the air to prepare a second catalyst layer forming slurry B.

The above slurry A was applied to a part extending to the length of 50% of the length of an exhaust gas passage from the end of the exhaust gas introduction port side toward exhaust gas discharge port side of a honeycomb base material which was the same one as that of Example 1 and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a first catalyst layer having a structure in which palladium was supported as a catalyst component to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide.

Then, the above slurry B was applied to a part extending to the length of 90% of the length of the exhaust gas passage from the end of the exhaust gas discharge port side toward exhaust gas introduction port side of the honeycomb base material formed with the first catalyst layer and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a second catalyst layer having a structure in which platinum and rhodium were supported as catalyst components to a fire resistant inorganic compound constituted of a mixture of γ -alumina and a ceria-zirconia composite oxide, to thereby obtain an exhaust gas purifying catalyst. The amount of the supported catalyst of the obtained exhaust gas purifying catalyst per 1 L of the honeycomb base material was as follows: palladium in the first catalyst layer was 2.6 g and platinum and rhodium in the second catalyst layer were 0.16 g and 0.32 g respectively.

Comparative Example 5

The same slurry A that was used in Example 7 was applied to a part extending to the length of 50% of the length of an exhaust gas passage from the exhaust gas introduction port side of a honeycomb base material which was the same one as that of Example 1, then, applied to a part extending to the length of 50% of the length of an exhaust gas passage from the exhaust gas discharge port side, and then calcined at 500°C for 1 hour in the air atmosphere to thereby form a first catalyst layer carrying palladium.

Then, the same slurry B that was used in Example 1 was applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust gas introduction port side of the honeycomb base material formed with the first catalyst layer, then, applied to a part extending to the length of 50% of the length of the exhaust gas passage from the exhaust gas discharge port side and then calcined at 500°C for 1 hour

in the air atmosphere to thereby form a second catalyst layer carrying platinum and rhodium, to thereby obtain an exhaust gas purifying catalyst. The amount of the supported catalyst of the obtained exhaust gas purifying catalyst per 1 L of the honeycomb base material was as follows: palladium in the first catalyst layer was 2.6 g and platinum and rhodium in the second catalyst layer was 0.16 g and 0.32 g respectively.

The purifying performances of the exhaust gas purifying catalysts of Example 7 and Comparative Example 5 were evaluated according to the following EU mode purification performance. The results are shown in Table 3.

EU mode purification performance.

The exhaust gas purifying catalyst was put in a catalyst package can, which was then installed in the exhaust system of a 4000 cc gasoline engine. Regular gasoline was used as the fuel and the air/fuel ratio (A/F) of exhaust gas passing through the catalyst was varied on a 10-sec cycle: rich (A/F = 13.5): 5 sec and lean (A/F = 15.5): 5 sec. The temperature in the catalyst bed was 950°C and the catalyst bed was allowed to stand for 50 hours. Moreover, the catalyst bed was allowed to stand at 600°C for 10 hours while the air/fuel ratio was varied on a 10-sec cycle in the same manner as above.

Then, the exhaust gas catalyst was put in a separate catalyst package can and then disposed right under a 1500 cc gasoline engine. Regular gasoline was allowed to burn to thereby evaluate the ability to purify non-methane hydrocarbon (NMHC), carbon monoxide (CO) and nitrogen oxide (NO_x) according to the EU mode (actual car exhaust gas mode). For the evaluation, a tester (trade name: MEXA 9000, manufactured by Horiba, Ltd.) was used. The smaller the numerical value in Table 3 is, the more excellent the catalyst is shown to be.

[Table 3]

	EU mode purification performance (Total emission, g/km)		
	NMHC	CO	NO _x
Example 7	0.042	0.47	0.038
Comparative Example 5	0.052	0.41	0.040

Although the invention is illustrated and described herein with reference to specific embodiments, the invention is not intended to be limited to the details shown. Rather, various modifications may be made in the details within the scope and range of equivalents of the claims and without departing from the invention.

What is claimed is:

1. An exhaust gas purifying catalyst in an exhaust gas passage penetrating through a base material from an exhaust gas introduction port side to an exhaust gas discharge port side, the catalyst comprising a first and a second catalyst layer each containing a fire resistant inorganic compound carrying a catalyst component, wherein each catalyst layer is formed by supporting the catalyst component on a different fire resistant inorganic compound, the first catalyst layer extended from the exhaust gas introduction port side to the exhaust gas discharge port side and the second catalyst layer extended from the exhaust gas discharge port side to the exhaust gas introduction port side, the first and second catalyst layers being formed such that the catalyst layers are partly overlapped on each other, the exhaust gas introduction port side is coated only with the first catalyst layer, and the exhaust gas discharge port side is coated only with the second catalyst layer.
2. The exhaust gas purifying catalyst according to claim 1, wherein the exhaust gas passage has a total passage length, the first catalyst layer extending a length of 40% or more to less than 100% of the total passage length from the exhaust gas introduction port side to the exhaust gas discharge port side, and the second catalyst layer extending a length of 40% or more to less than 100% of the total passage length from the exhaust gas discharge port side to the exhaust gas introduction port side such that the first and second catalyst layers are partly overlapped on each other.
3. The exhaust gas purifying catalyst according to claim 2, wherein after the first catalyst layer extending from the exhaust gas introduction port side to the exhaust gas discharge port side is formed, the second catalyst layer extending from the exhaust gas discharge port side to the exhaust gas introduction port side is formed.
4. The exhaust gas purifying catalyst according to claim 2, wherein after the second catalyst layer extending from the exhaust gas discharge port side to the exhaust gas introduction port side is formed, the first catalyst layer extending from the exhaust gas introduction port side to the exhaust gas discharge port side is formed.
5. The exhaust gas purifying catalyst according to claim 3, wherein the first catalyst layer comprises as the catalyst component a precious metal selected from the group consisting of platinum, palladium, rhodium, and platinum/palladium; and the second catalyst layer comprises as the catalyst component a precious metal selected from the group of platinum, palladium, rhodium, rhodium/platinum and rhodium/palladium.
6. The exhaust gas purifying catalyst according to claim 3, wherein the first catalyst layer comprises as the catalyst component a precious metal selected from the group consisting of platinum, palladium, rhodium, rhodium/platinum and rhodium/palladium; and the second catalyst layer comprises as the catalyst component a precious metal

selected from the group consisting of platinum, palladium, rhodium and palladium/platinum.

7. The exhaust gas purifying catalyst according to claim 2, wherein the first catalyst layer extends a length of 45% or more to less than 90% of the total passage length from the exhaust gas introduction port side to the exhaust gas discharge port side, and the second catalyst layer extending a length of 45% or more to less than 90% of the total passage length from the exhaust gas discharge port side to the exhaust gas introduction port side such that the first and second catalyst layers are partly overlapped on each other.
8. The exhaust gas purifying catalyst according to claim 1, wherein the base material comprises a material selected from the group consisting of cordierite, metal, silicon carbide, silicon nitride, and aluminum nitride, and mixtures thereof.
9. The exhaust gas purifying catalyst according to claim 1, wherein the catalyst component is selected from the group consisting of nickel, copper, manganese, iron, cobalt, zinc, gold, silver, ruthenium, rhodium, palladium, osmium, iridium, and platinum, and mixtures or combinations thereof.
10. The exhaust gas purifying catalyst according to claim 9, wherein the catalyst component is a mixture of nickel and platinum or palladium.
11. The exhaust gas purifying catalyst according to claim 1, wherein the fire resistant inorganic compound is one or more types of compounds selected from the group consisting of alumina, silica alumina, zeolite, titanium oxide, silica, ceria, and zirconia, and the composite oxides thereof, and mixtures or combinations thereof, and the fire resistant inorganic compound of the first catalyst layer and the second catalyst layer differ in composition and/or type.
12. The exhaust gas purifying catalyst according to claim 1, wherein the fire resistant inorganic compound is a powder having an average particle diameter of 2 to 10 microns (μm).
13. An exhaust gas purifying system comprising
 - a base material having a total exhaust passage length extending from an exhaust gas introduction port side to an exhaust gas discharge port side,
 - a first catalyst layer comprising a first fire resistant inorganic compound carrying a catalyst component, the first catalyst layer extending from the exhaust gas introduction port side to the exhaust gas discharge port side, and
 - a second catalyst layer comprising a second fire resistant inorganic compound carrying a catalyst component, the second catalyst layer extending from the exhaust gas discharge port side to the exhaust gas introduction port side, andwherein the exhaust gas introduction port side is coated only with the first catalyst layer in a portion 'B' of the total exhaust passage length, and the exhaust gas discharge

port side is coated only with the second catalyst layer in a portion 'C' of the total passage length, and the first and second catalyst layers are partly overlapped on each other in a portion 'A' extending a length of 20% or more to less than 90% of the total passage length.

14. The exhaust gas purifying system according to claim 13, wherein the portion 'A' extends a length of 30% or more to less than 80% of the total passage length.

15. The exhaust gas purifying system according to claim 13, wherein a ratio of the portion 'B' to the portion 'C' is from about 1:1 to about 1:5, such that the portions 'B' and 'C' overlap to form the portion 'A'.

16. The exhaust gas purifying system according to claim 13, wherein the base material comprises a material from the group consisting of cordierite, metal, silicon carbide, silicon nitride, and aluminum nitride, and mixtures thereof.

17. The exhaust gas purifying system according to claim 13, wherein the catalyst component is selected from the group consisting of nickel, copper, manganese, iron, cobalt, zinc, gold, silver, ruthenium, rhodium, palladium, osmium, iridium, and platinum, and mixtures or combinations thereof, and the catalyst components of the first catalyst layer and the second catalyst layer are the same or are different.

18. The exhaust gas purifying system according to claim 13, wherein the first and second fire resistant inorganic compounds are one or more types of compounds selected from the group consisting of alumina, silica alumina, zeolite, titanium oxide, silica, ceria, and zirconia, and the composite oxides thereof, and mixtures or combinations thereof, and the first and second fire resistant inorganic compounds differ in composition and/or type.

19. A method of making an exhaust gas purifying system comprising
preparing a base material having a plurality of exhaust gas passages and a total exhaust passage length extending from an exhaust gas introduction port side to an exhaust gas discharge port side, the base material comprising a material from the group consisting of cordierite, metal, silicon carbide, silicon nitride, and aluminum nitride, and mixtures thereof,

immersing the base material in a first catalyst slurry at a length of 40% or more to less than 100% of the total passage length from the exhaust gas introduction port side to the exhaust gas discharge port side, the first catalyst slurry comprising a first fire resistant inorganic compound carrying a catalyst component, followed by drying and calcining to form a first catalyst layer on the base material, and

immersing the base material in a second catalyst slurry at a length of 40% or more to less than 100% of the total passage length from the exhaust gas discharge port side to the exhaust gas introduction port side, the second catalyst slurry comprising a second fire resistant inorganic compound carrying a catalyst component, followed by drying and calcining to form a second catalyst layer on the base material,

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wherein the exhaust gas introduction port side is coated only with the first catalyst layer in a portion 'B' of the total exhaust passage length, and the exhaust gas discharge port side is coated only with the second catalyst layer in a portion 'C' of the total passage length, and the first and second catalyst layers are partly overlapped on each other in a portion 'A' extending a length of 20% or more to less than 90% of the total passage length.

20. The method of making an exhaust gas purifying system of claim 19, wherein the first catalyst slurry and the second catalyst slurry further comprise alkali metals, alkali earth metals, or rare earth elements.

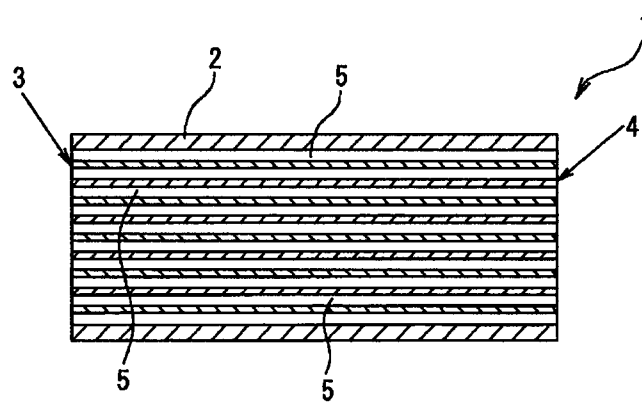


FIG. 1

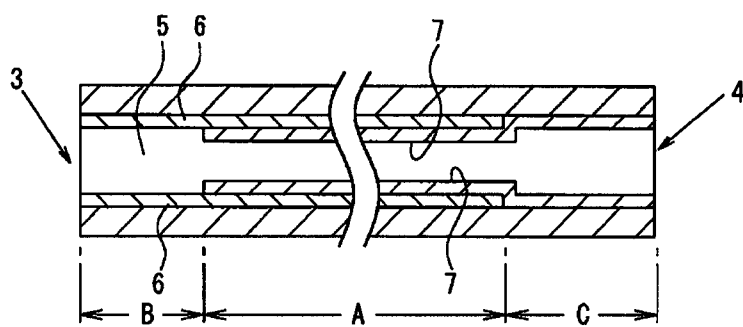


FIG. 2

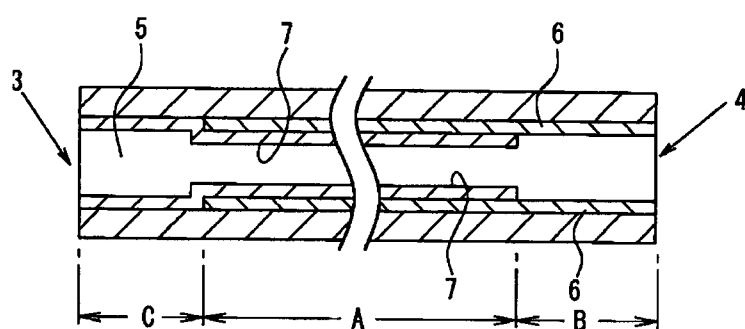


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2011/001838

A. CLASSIFICATION OF SUBJECT MATTER
INV. B01J35/00 B01J35/04 B01D53/94
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B01J B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	US 2008/045405 A1 (BEUTEL TILMAN WOLFRAM [US] ET AL) 21 February 2008 (2008-02-21) claims; examples -----	1-20
X	WO 2004/002621 A2 (ENGELHARD CORP [US]) 8 January 2004 (2004-01-08) claims; examples -----	1-20
X	WO 2008/022967 A1 (UMICORE AG & CO KG [DE]; KOEGEL MARKUS [DE]; PFEIFER MARCUS [DE]; JESK) 28 February 2008 (2008-02-28) claims; examples -----	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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Schoofs, Bart

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2011/001838

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