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KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA,  
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NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS,  
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GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a  
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[Continued on next page]

(54) Title: NON-WOVEN FIBROUS MATERIAL-BASED HONEYCOMB CATALYST

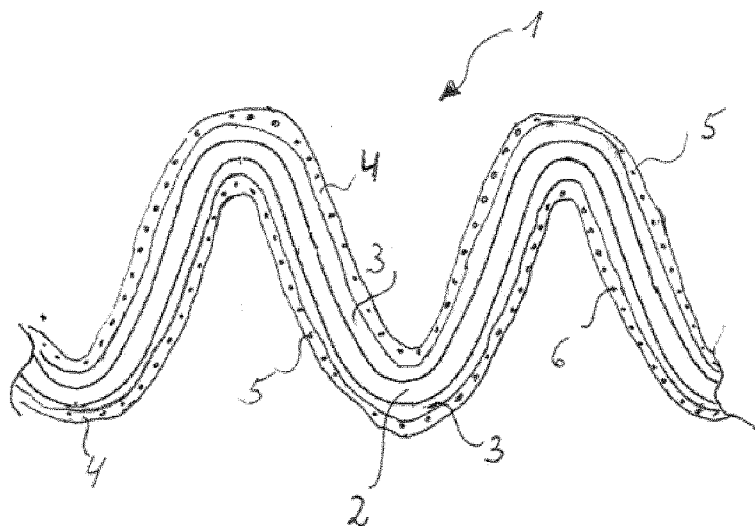


Fig. 1

(57) Abstract: A honeycomb catalyst with a plurality of flow through channels, wherein the honeycomb catalyst comprises a corrugated substrate and optionally a liner applied on the corrugated substrate, the substrate and the optional liner are composed of a non-woven fibrous material, such as glass fibres, with a first coat of a ceramic material and a washcoat layer applied on the first coat ceramic material, the washcoat containing one or more catalytically active metals and/or metal oxides, such as vanadium oxide, tungsten oxide, zeolitic material, platinum and/or palladium.

- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
- *of inventorship (Rule 4.17(iv))*
- Published:**
- *with international search report (Art. 21(3))*

## NON-WOVEN FIBROUS MATERIAL-BASED HONEYCOMB CATALYST

The present invention relates to a honeycomb shaped catalyst formed of a corrugated substrate composed of a non-woven fibrous material.

In particular, the invention provides an improved honeycomb shaped catalyst prepared from corrugated sheets of a non-woven fibrous material, preferably provided with a flat liner.

We have found that a stable honeycomb shaped catalyst can be made of non-woven fibrous material, for instance E-glass fibers as starting material, when coating the material with a first coat layer prior to corrugating and forming the fibrous material into a corrugated sheet. The first coat layer is applied as an aqueous suspension of ceramic material.

We have additionally found that when the first coat layer is applied on the substrate in an amount resulting in a total weight of substrate and coat layer of between 60-100 g/m<sup>2</sup> results in an improved stability and stiffness of the paper so that waves formed in the corrugation process substantially retain their shape in subsequent forming stages of the final honeycomb catalyst product and operation of the honeycomb catalyst product.

Pursuant to the above finding, this invention provides a honeycomb catalyst with a plurality of flow through channels, wherein the honeycomb catalyst comprises a corrugated substrate and optionally a liner applied on the corrugated substrate, the substrate and the optional liner are com-

posed of non-woven fibrous material with a first coat of a ceramic material in an amount to result in total weight of the substrate and first coat of between 60-100 g/m<sup>2</sup> and a washcoat layer applied on the first coat, the wash coat  
5 contains or is impregnated with one or more catalytically active compounds.

The first coat ceramic material comprises preferably titania, silica and/or kaolin. The first coat can be applied on  
10 the substrate sheet in form of an aqueous slurry, having a total solid content of 15 - 25 wt%, on one side of the sheet or on both sides of the sheet.

In both coating methods, the slurry penetrates the sheet.  
15

A honeycomb body is formed by stacking up a plurality of the coated and corrugated sheets, or by rolling-up a single coated and corrugated sheet, preferably lined with a flat liner, into a rectangular or cylindrical honeycomb body. In  
20 each case the formed honeycomb body has a plurality of parallel flow through channels formed by waves of the corrugated sheet(s) and the optional liner applied on the corrugated sheet(s).

To obtain the final honeycomb catalyst product, the honeycomb body pre-coated with the first coat is formed by  
25 stacking up or rolling up the coated corrugated sheet(s) and the coated liner if present, and is subsequently coated with the washcoat.

30

The washcoat acts as a carrier for the catalytic materials and is used to disperse the materials over a large surface

area. Alumina, titania, silica, or mixtures thereof can be used. Preferably, the washcoat consists of titania.

5 Washcoating of the honeycomb body is usually performed by slurry pickup in the honeycomb body pre-coated with the first coat by pouring the washcoat slurry into the channels of the honeycomb body, or by dipping the body at one side into the washcoat slurry and optionally applying vacuum at the opposite side.

10

There are two possible methods of catalysing the honeycomb body.

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In one method the washcoat contains the catalytic active material.

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In the other method, the pre-coated and washcoated honeycomb body is finally impregnated with an aqueous solution containing one or more precursors of the desired catalytically active material, followed by drying and calcination.

In summary, a honeycomb catalyst according to the invention can be prepared by a method comprising the steps of

25

- (a) providing a sheet of non-woven fibrous material;
  - (b) coating the sheet with an aqueous suspension of a ceramic material; partly removing the moisture from the coated sheet prior to
  - (c) corrugating the coated sheet;
  - (d) rolling-up or stacking up the coated and corrugated sheet(s) into a spiral-wound cylindrical body or staked up
- 30 rectangular body;

(e) washcoating the cylindrical or rectangular body, optionally containing the catalytic active components or precursors thereof and

(f) drying and optionally calcining the washcoated body;  
5 or alternatively

(e1) impregnating the washcoated body with a solution of catalytic active components or precursors thereof, if not contained in the washcoat of step e);

(f1) drying and calcining the body of step (e1) to obtain  
10 the final honeycomb catalyst.

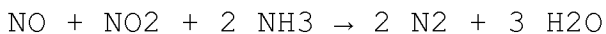
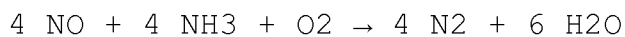
Honeycomb catalysts are typically employed in the cleaning of engine exhaust gas. For this purpose the honeycomb catalyst is shaped as a cylindrical body and canned in a metal housing with a mat between the honeycomb catalyst body and the metallic housing. In the canning process the cylindrical honeycomb body is radially compressed in order to provide sufficient friction between the mat and the body and between the mat and the metallic housing. Radially compression typically causes cracks in the coated and calcined  
15 body. Thus, a further advantage of the first coat provided on the substrate is that the canning process causes a much reduced cracking of the honeycomb body.  
20

25 The canned honeycomb catalyst is as mentioned above typically used in the catalytically removal of noxious compounds in the exhaust gas, including nitrogen oxides, unburnt engine fuel and carbon monoxide.

30 Thus, it is preferred that the catalytically active compounds of the honeycomb catalyst are active in the removal of noxious compounds in engine exhaust gas.

Catalyst compounds active in engine exhaust gas cleaning are per se known in the art. To name a few, typically employed catalysts are vanadium oxide, tungsten oxide, palladium and platinum, and zeolitic material either used alone or as mixtures thereof.

When operating the honeycomb shaped catalyst in the removal of nitrogen oxides contained in exhaust or off-gasses, the nitrogen oxides are converted to free nitrogen with a reducing agent, typically ammonia, in the presence of an SCR catalyst by selective, catalytic reduction:



Any of the known SCR catalyst compositions will be suitable for use in the invention.

Fig. 1 of the drawings is a sectional view of a honeycomb catalyst according to the invention.

As seen in Fig. 1, the substrate 1 of a honeycomb catalyst according to the invention is composed of a corrugated sheet 2 of non-woven fibrous material substrate, optionally provided with a liner (not shown). Substrate 1 can be rolled-up to a cylindrical body.

A first coat layer 3 made of ceramic material is coated on sheet 2. The first coat material can also diffuse through the fibrous material of sheet 2 and forms a first coat lay-

er on both sides of sheet 2 and within the fibrous material, as shown in Fig.1. A washcoat layer 4 is coated on the first coat layer 3. Washcoat layer 4 contains catalyst particles 5.

**CLAIMS**

1. A honeycomb catalyst with a plurality of flow through channels, wherein the honeycomb catalyst comprises a corrugated substrate and optionally a liner applied on the corrugated substrate, the substrate and the optional liner are composed of non-woven fibrous material with a first coat of a ceramic material in an amount to result in total weight of the substrate and first coat of between 60-100 g/m<sup>2</sup> and a washcoat layer applied on the first coat, the wash coat contains or is impregnated with one or more catalytically active compounds.
2. The honeycomb catalyst of claim 1, wherein the the corrugated substrate comprises one or more sheets of non-woven glassfibers.
3. The honeycomb catalyst of claim 1 or 2, wherein the ceramic material of the first coat comprises titania, silica and/or kaolin.
4. The honeycomb catalyst of claim 1 or 2, wherein the ceramic material of the first coat consists of titania and silica.
5. The honeycomb catalyst according to any one of claims 1 to 4, wherein the honeycomb catalyst is in form of a rolled-up cylindrical body.
6. The honeycomb catalyst according to any one of claims 1 to 5, wherein the washcoat layer comprises titania.

7. The honeycomb catalyst according to any one of claims 1 to 6, wherein the one or more catalytically active compounds are active in the removal of noxious compounds in engine exhaust gas.

5

8. The honeycomb catalyst according to any one of claims 1 to 6, wherein the one or more catalytically active compounds comprise at least one of vanadium oxide, tungsten oxide and zeolitic material.

10

9. The honeycomb catalyst according to any one of claims 1 to 6, wherein the one or more catalytically active compounds comprise platinum and/or palladium.

15

10. The honeycomb catalyst of any one of claims 2 to 9, wherein the glassfibers consist of E-glass.

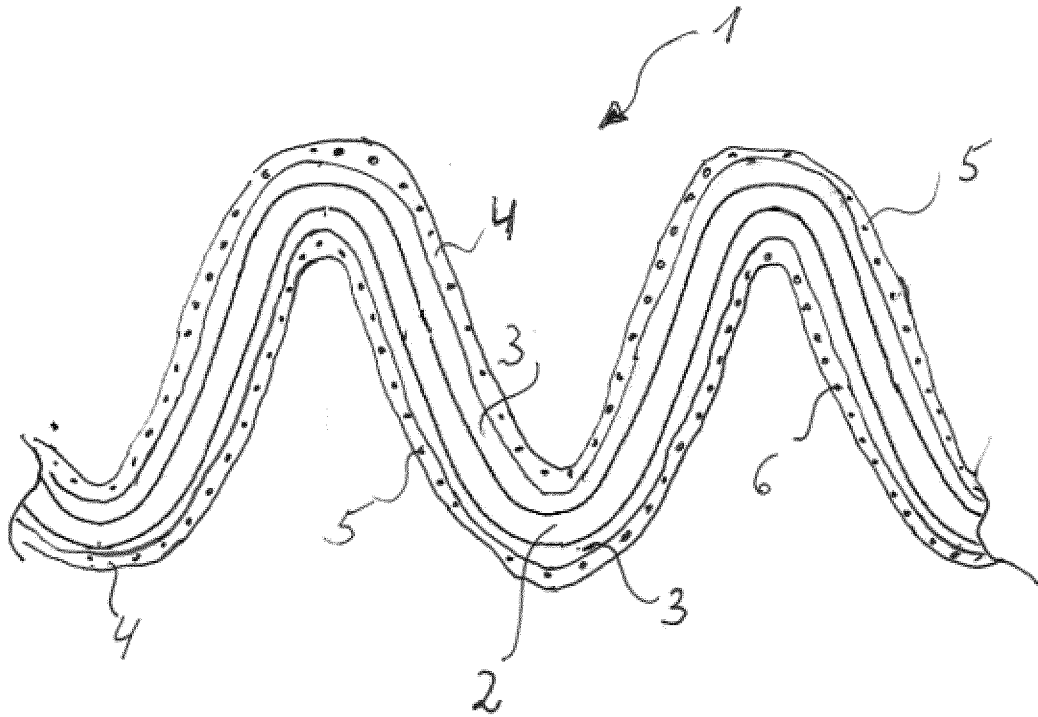


Fig. 1

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/EP2017/054881

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>					
INV.	B01J35/04	B01J35/06	B01J37/02	B01J23/22	B01J23/28
	B01J23/30	B01J23/42	B01J23/44	B01J23/64	B01J29/00
	B01D53/94				
According to International Patent Classification (IPC) or to both national classification and IPC					

<b>B. FIELDS SEARCHED</b>
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 practicable, 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.
X	US 5 194 414 A (KUMA TOSHIMI [JP]) 16 March 1993 (1993-03-16) abstract figures 1, 2 column 1, line 8 - line 16 column 2, line 7 - line 37 column 2, line 51 - line 55 column 2, line 61 - column 3, line 2 column 3, line 16 - line 48 column 3, line 53 - column 5, line 26 ----- -/--	1-10

Further documents are listed in the continuation of Box C.  See patent family annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search <b>19 April 2017</b>	Date of mailing of the international search report <b>15/05/2017</b>
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer <b>Schön, Anke</b>
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## INTERNATIONAL SEARCH REPORT

International application No  
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C(Continuation). 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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Information on patent family members

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