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(54) METHOD FOR ARRANGING ABRASIVE PARTICLES OF A GRIND TOOL ORDERLY

(57) A method for uniformly distributing abrasive grits (1) on grinding tools (10) comprises the steps of: forming a substrate layer (11, 12, 13, 14) and an adsorbent template (20), designing a single layer template (20) based on the tactic requirement of the abrasive grits (1) such as diamond etc., said template (20) having one adsorbent layer that can adsorb the diamond grits (1) upon the template (20), placing said template (20) upon the substrate layer (11, 12, 13, 14), pressing the diamond particles (1) into the substrate layer (11, 12, 13, 14), so that the diamond grits (1) are distributed in order in the substrate layer (11, 12, 13, 14) . Said grinding tool (10) applies to the cutting end of a diamond tool and diamond tools for cutting and grinding several kinds of hard and friable materials, such as granite, marble, concrete and bitumen etc.

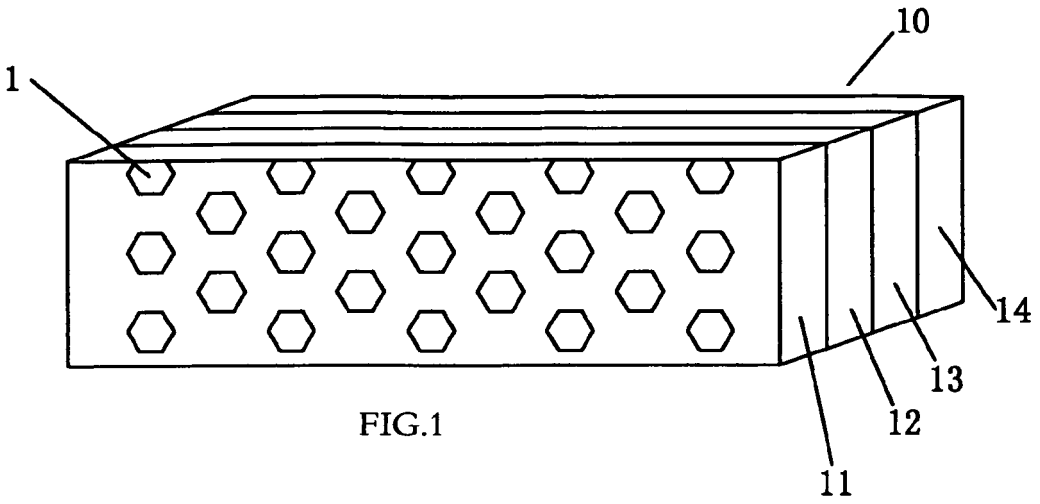

FIG.1

EP 2 184 134 A1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to the improvement of cutting, grinding tools, such as the cutting segments of diamond tools and the other diamond tools, which are typically used in cutting and drilling various hard and fragile materials, such as granites, marbles, concretes, asphalts, etc. More particularly, the present invention relates to the uniform distribution of abrasive particles such as diamond grits on the segment of cutting tools to increasing the cutting efficiency.

BACKGROUND OF THE INVENTION

[0002] Synthetic diamonds are the hardest abrasive material currently known: they have been widely used as super-abrasives on cutting and grinding tools. The diamond tools are particularly used to cut and grind rocks in machining stone and the other structural components. Mostly, the diamond tools have cutting segments on which the diamond or other abrasive particles are distributed; the cutting segments are fixed on the tool bodies.

[0003] A satisfactory structure of diamond saw blade is that the diamond particles have a big exposed portion and a proper spacing of particles to improve the excluding of debris and the transporting of cooling fluid, thus improving the cutting efficiency and lengthening the useful life of the tools. A uniform distribution of abrasive grits can also improve the safety in manufacture. A typical abrasive tool, such as a diamond saw blade, is manufactured by mixing diamond particles (e.g., 40/50 U.S. mesh) with a suitable support matrix (bond) powder (e.g. cobalt powder of 1.5 micrometer in size). The mixture is then compressed in a mold to form the right shape. This "green" form of the tool is then consolidated, by sintering at a temperature between 700-1200 °C, to form a single body with a plurality of abrasive particles therein. Finally, the consolidated body is brazed to a tool body, such as the round blade of a saw, to form a cutting tool.

[0004] Different applications, however, require different combinations of diamond and support matrix. For example, drilling and sawing applications may require a large-sized (20 to 60 U.S. mesh) diamond grit to be mixed with a metal powder. The metal powder is typically selected from cobalt, nickel, iron, copper, bronze, alloys thereof, and/or mixtures thereof; for grinding applications, a small-sized (60/400 U.S. mesh) diamond grit is mixed with either metal (typically bronze), ceramic/glass (typically a mixture of oxides of sodium, potassium, silicon, and aluminum) or resin.

[0005] Because diamond is much larger than the matrix powder, and it is much lighter than the latter, it is very difficult to mix the two to achieve uniformity. Moreover, diamond particles can still segregate from metal powder in the subsequent treatment such as pouring the mixture into a mold, or when the mixture is subjected to vibration.

[0006] One method used in an attempt to make the diamond distribution uniform is to wrap diamond particles with a coating of matrix powder. The concentration of diamond particles in each diamond tool is tailored for a particular application; the concentration determines the average distance between diamond particles. If one thickly coated diamond mixes the coated particles together, the distribution of diamond would be controlled by the thickness of coating and may become uniform. Additional metal powder may be added as an interstitial filler between these coated particles to increase the packing efficiency, so the consolidation of the matrix powder in subsequent sintering would be easier.

[0007] Although the above-described coating metal has certain merit, in practice, uniformity of coating is very difficult to achieve. For example, Chen and Sung (U.S. Pat. Nos. 5024680 and 5062865) describe a chemical vapor deposition (CVD) method for coating diamond grit using a fluidized bed. However, most of these methods can only produce thin coatings such as a few micrometers that do not affect the diamond distribution. Moreover, chemical coating methods typically require treatment at high temperatures such as greater than 900 °C that may cause damage to diamond. It is well known that synthetic diamond grit tends to form micro-cracks above this temperature.

[0008] Dr. Song Jian Min of Taiwan has invented a two-dimensional method, firstly providing a layer of support matrix, and disposing abrasive grits in the support matrix layer in a desired pattern. After the diamond particles are plated into the metal matrix layer according to a predetermined pattern, the process may be repeated until a desired number of layers have been formed. The layers are then assembled to form the desired three-dimensional body. Subsequently the diamond tool is consolidated to form the final product.

[0009] The detailed above-mentioned method is that: firstly a thin layer of bonding matrix, i.e. a two-dimensional body, is formed. A template is then disposed on the boding matrix. The template has a plurality of apertures formed therein which are sized to receive an abrasive grit of a particular size, with one particle being disposed in each aperture: as the particles are filled into the apertures, they may be subjected to pressure or moved into the boding matrix. However, the abrasive particles are small to 40/50 U.S. mesh, and it is impossible to fill the apertures with abrasive particles one by one, so this method cannot achieve industrialization.

[0010] In summary, current arts are incapable of controlling the uniformity of diamond in cutting tools efficiently. Likewise, the current methods are inadequate to provide effective control of various sizes and concentration variations of different parts of the same tool.

SUMMARY OF THE INVENTION

[0011] Performance of diamond arranged in a predetermined pattern /uniform distribution:

[0012] The distance between diamond or other abrasive particles determines the workload each particle will perform. Improper spacing of the abrasive particles will lead to premature failure of the abrasive surface or structure. Thus, if the abrasive particles are too close to one another, some of the particles are redundant and add the cost. Moreover, these non-performing particles can block the passage of debris, thereby reducing the cutting efficiency.

[0013] If the diamond grits are uniform distributed, the distance between the grits will be optimized according to the cutting materials and cutting conditions. It has been found that in practice, 85% of the distance between diamond grits on uniform distributed saw blade is 2mm-5mm, while on traditional saw blade, this distance percent is only 60%. The increase of diamond content weakly affects the workload, but the applicable cutting times are lengthened markedly, thus the cutting efficiency increased and the useful time of the saw blade are lengthened.

[0014] Diamond concentration: when the concentration of diamond increases, the useful time of uniformly distributed diamond will be lengthened in geometric series, and maintaining favorable cutting and sawing capability at the same time, but when the concentration increases more, the cutting and sawing capability will be reduced.

[0015] The exposed height of diamond particularly affects the sawing efficiency and the useful time of the saw blade: it rests with the size and the distribution of diamond and the hold of the sheet. So, the uniform distribution of diamond or other abrasive particles on matrix will markedly affect the cutting and grinding tools.

[0016] Object of the present invention is providing a method of arranging the abrasive particles uniformly on cutting and grinding tools, and the method can be industrialized.

[0017] One art of the present invention is to provide a sheet; a template, designed on the single-layer arranging requirement of diamond or the other abrasive particles, said template having a layer of adsorbent which can adsorb a single layer of diamond grits.

[0018] Place the template on the sheet, press the diamond grits into the sheet, the diamond grits will be embedded uniformly on the sheet at a layer.

[0019] Said template comprises an adsorbent, wherein the adsorbent has a lower viscosity, a higher percent of condensate and a lower percent of solvent.

[0020] Said sheet is a paste: after the diamond is pressed into it, the paste would be solidified by means of heating or cooling to be a sheet with a single layer of uniformly-distributed diamond grits.

[0021] Said sheet is made of the mixing of metal powder and bond: when the mixing is about to solidify, press the abrasive particles into one surface or double surface of the sheet.

[0022] Press a plurality of above-mentioned sheets to be a unity on the thickness requirement of cutting tool, then place them into a mold to be sintered.

[0023] Said cutting tool includes multiple sheets, and the distribution pattern of abrasive particles on each layer is the same or different; for example, the outer layer has a higher density of diamond while the inner layer has a lower density and bigger-size diamond.

[0024] Another art of the present invention is as follows:

a sheet;

an electric/electromagnetic template, designed on the arranging requirement of diamond or the other abrasive particles;

diamond or the other abrasive particles are adsorbed on the template in a layer.

[0025] Press the template with the adsorbed diamond into the sheet, then separate the template, the diamond grits will be uniformly distributed on the sheet.

[0026] Said template is a plane template formed by the following steps: after electromagnetic radiating, covering the positions where does not need to adsorb abrasive particles, thus an electromagnetic template is formed.

[0027] Said template can be a plasma-template.

[0028] Said template can be an electric template with positive or negative charge.

[0029] Said sheet is made by the mixing of metal powder and bond compressed in a mold.

[0030] Select needed layers of sheets on the requirement of cutting, compress the above-mentioned multiple sheets to be a unity by static press or stamping press, then place them into a mold to be sintered.

[0031] Said cutting tool is formed by multiple sheets, and the distribution pattern of abrasive particles on each layer is the same as or different; for example, the outer layer has a higher density of diamond while the inner layer has a lower density and bigger-size diamond.

[0032] Therefore, the present invention provides a template, the shape and the pattern of the template can be designed conveniently on the arranging requirement of abrasive particles, and the template can adsorb only a single layer of abrasive particles; place the template with uniformly distributed abrasive particles into or adhere to sheet, then a sheet will be formed with uniformly distributed abrasive particles, thus the position of abrasive particles can be located exactly on the sheet on predetermination. The abrasive particles can be uniformly distributed, or arranged on the requirement of accounted cutting force of provided cutting and grinding tools. For example, higher concentration diamond grits are preferred in the edge and front of saw, while in the middle, the lower concentration diamond grits are preferred.

[0033] In practice, compared with irregularly distributed diamond saw blades, the saw blade with uniformly distributed diamond grits has a lower concentration diamond grits, the practical cutting distance is 1150 m (the distance of irregularly distributed diamond saw blade is 450 m), the blade cuts smoothly and there are no col-

lapsed pieces of blade, the sum powder consumption of abrasive tools decreases by 30 percents, the noise of perigee decreases by 10 db (A), cutting efficiency increases by 30 percent, and the useful life is three times longer than those irregularly distributed diamond saw blades.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034]

Fig. 1 shows the uniform distribution of abrasive particles formed by three sheets.

Fig. 2 is a view of the template structure, wherein Fig. 2A shows the oblique distribution of abrasive particles; Fig. 2B shows the forward distribution of abrasive particles; Fig. 2C shows the cross distribution of abrasive particles.

Fig. 3 shows the diamond grits adsorbed on the electromagnetic template.

Fig. 4 shows another layout of a segment of a cutting tool formed by multiple sheets of the present invention.

DETAILED DESCRIPTION

Embodiment 1

[0035] Referring to Fig. 1, it shows a perspective view of a segment of diamond tool, indicated with 10. The segment 10 is formed by a plurality of layers, 11, 12, 13 and 14, which are impregnated with abrasive grits, indicated as hexagonal frame 1.

[0036] Referring to Fig. 2, the electromagnetic template 20 of the present invention is capable of adsorbing a single layer of abrasive particles (for example, diamond grits) after corona discharging; when the adsorptive points are occupied by the adsorbed diamond grits, the other grits cannot be adsorbed on the same place, so the adsorbed grits form a single layer, and template can be designed on the requirement of the arrangement of diamond or other abrasive particles, thus the diamond, cubic boron nitride grits are uniformly distributed on the template, and the distribution form can be designed freely on the desire of designers.

[0037] Fig. 2 is a view of the distribution of abrasive particles on the template, wherein Fig. 2A shows the oblique distribution of abrasive particles; Fig. 2B shows the forward distribution of abrasive particles; Fig. 2C shows the cross distribution of abrasive particles.

[0038] In practice, the template may be a plane as referred to Fig. 3; in addition, a cover 21 is adhered on the template, which covers the positions where it is not necessary to adsorb abrasive particles, when the abrasive particles such as diamond grits are adsorbed on the template: then a uniform distribution of diamond grits on the template is achieved; the advantage of this method is that the template is easily treated with, and the shape of cover is freely and easily treated.

[0039] With reference to sheet 30, there are many ways to make the sheet: for example, the powder can first be mixed with a suitable binder (typically organic) and a solvent that can dissolve the binder. In order to prevent the powder from agglomerating during the processing, a suitable wetting agent (e.g. , phosphate ester) may also be added. The slurry can then be poured onto a tape and pulled underneath a blade or leveling device, then the sheet would be made. The tape casting method is a well known method in rubber and plastic manufacturing. By adjusting the gap between the blade and the tape, then the slurry can be cast into a sheet with the right thickness.

[0040] It is desirable to make the sheets pliable for subsequent treatments (e.g., bending over the tool substrate which has a curvature). Therefore, a suitable organic plasticiser can also be added to provide the desired characteristics. The use of organic agents for powder processing is documented in many textbooks and it is well known by those skilled in the art. Typical binders include polyvinyl alcohol (PVA), polyvinyl butyral (PVB), polyethylene glycol (PEG), paraffin, phenolic resin, and acrylic resin. Typical binder solvents include methanol, ethanol, acetone, trichloroethylene, toluene, etc. Typical plasticisers are polyethylene glycol, diethyl oxalate, triethylene glycol dihydroabietate, glycerin, rosin, etc. The organic agents so introduced are used to facilitate the fabrication of metal layers. They must be removed before the consolidation of metal powders. The binder removal process is also well known to those skilled in the art.

[0041] Once the sheet 30 is formed, a template impregnated with diamond or other abrasive particles is laid on the top of the sheet. After the template is properly positioned, press the abrasive particles into the sheet, remove the template, then the abrasive particles are uniformly distributed on the sheet. The depth of the abrasive particles embedded in the sheet can be designed according to requirements, and those skilled in the art will know that the desirable height of the abrasive particles extends outwardly from the sheet.

[0042] The manufacture of template may be the following: after electromagnetic radiating on a metal template, the template will be provided with adsorbing power, then place a cover (e.g. a cardboard) on the template, covering the positions where it is not necessary to adsorb abrasive particles, thus the template can achieve uniform distribution of abrasive particles.

[0043] Said template is preferred to be a plasma template, which has a good single layer adsorbing power.

[0044] Said template is an electric template, which has adsorbing power with negative charge.

[0045] Fig. 4 shows the sheets of the present invention with uniform distributed abrasive particles assembled transversely; the segment in Fig. 4 is formed of a plurality of transverse sheets 41. Its difference is that the segment is formed transversely, and it requires that the abrasive particles are distributed transversely on the tool, and the

template is made according to requirements. In summary, the location methods of abrasive particles are several, and the uniform distribution of abrasive particles according to the present invention can be conveniently achieved.

Embodiment 2

[0046] This is the same as embodiment 1, except that the template is with bond, whose adsorbing power is by chemical material other than by electromagnetic-adsorbing powder in embodiment 1.

Embodiment 3

[0047] A 40/50 U.S. mesh diamond grit (SDA-85, made by DE BEERS company) is provided. The sheet is a mixture of metal powder and acrylic resin. Five different proportions of cobalt and bronze were used for the metal powder. An acrylic binder was added to the mixture and the charge was blended to form a cake. The cake was then rolled between two rollers to form sheets with a thickness of 1 mm; place the template distributed with adsorbed diamond grits on the sheet, press the diamond grit into the sheet, then remove the template. These sheets were cut in the shape of diamond saw segments with a length of 40 mm and width of 15 mm. Three of each of such segments were assembled and placed into a typical graphite mold for making conventional diamond saw segments. The segments were pressed and heated by passing electric current through the graphite mold. After sintering for three minutes, the segments were consolidated to a height of 9 mm with less then 1% porosity. Twenty-four segments for each composition were fabricated, they were laser welded onto a circular saw whose diameter was 14 inches. The performance of these blades is better than those made by conventional methods in sawing the granite.

Industrial utility

[0048] The present invention provided an adsorptive template, the shape and the pattern of the template can be designed conveniently on the arranging requirement of abrasive particles, and the template can adsorb only a single layer of abrasive particles; place the template with uniformly distributed abrasive particles into or adhere it to the sheet, then a sheet with uniformly distributed abrasive particles will be formed, thus the position of abrasive particles can be located exactly on the sheet with determination. The abrasive particles can be uniformly distributed, or arranged on the requirement of accounted cutting force of provided cutting and grinding tools. For example, higher concentration diamond grits are preferred in the edge and front of saw, while in the middle, the lower concentration diamond grits are preferred.

Claims

1. A method for uniformly distributing abrasive grits on grinding tools comprising the steps of:

   providing a template, designed on a single-layer arranging requirement of diamond or other abrasive particles, the template having a layer of adsorbent which can adsorb a single layer of diamond grits;
   placing the template on the sheet, pressing the diamond grits into the sheet, and the diamond grits will be embedded uniformly on the sheet on a layer.

2. A method for uniformly distributing abrasive grits on grinding tools according to claim 1, wherein the template comprises adsorbent, said adsorbent having a lower viscosity, a higher percent of condensate and a lower percent of solvent.

3. A method for uniformly distributing abrasive grits on grinding tools according to claim 1, wherein the sheet is a paste, after the diamond being pressed into it, the paste solidifying by means of heating or cooling to be a sheet with a single layer of uniformly-distributed diamond grits.

4. A method for uniformly distributing abrasive grits on grinding tools according to claim 1, wherein the sheet is made from mixing metal powder and bond, when the mixing being about to solidify, pressing the abrasive particles into one surface or a double surface of the sheet.

5. A method for uniformly distributing abrasive grits on grinding tools according to claim 1, further comprising the steps of pressing a plurality of said sheets to be a unity on the required thickness of the cutting tool, then placing them into a mold to be sintered.

6. A method for uniformly distributing abrasive grits on grinding tools according to claim 1, wherein the cutting tool includes multiple sheets, the distribution pattern of abrasive particles on each layer being the same or different.

7. A method for uniformly distributing abrasive grits on grinding tools according to claim 1, wherein the outer layer of the cutting tool has a higher density of diamond while the inner layer has a lower density and bigger-size diamond.

8. A method for uniformly distributing abrasive grits on grinding tools according to claim 1 or 5, wherein the sheets impregnated with uniformly distributed diamond grit are cut diamond saw segments in a predetermined shape, a plurality of such segments be-

ing assembled and placed into a typical graphite mold for making conventional diamond saw segments, after sintering, the segments being consolidated, and then the segments being laser welded onto a circular saw according to requirements.

9. A method for uniformly distributing abrasive grits on grinding tools comprising the steps of:

providing a sheet;
providing an electric/electromagnetic template, designed on the arranging requirement of diamond or other abrasive particles, diamond or other abrasive particles being adsorbed on the template in a layer;
pressing the template with the adsorbed diamond into the sheet, then separating the template, the diamond grits being uniformly distributed on the sheet.

10. A method for uniformly distributing abrasive grits on grinding tools according to claim 9, wherein the template is a plane template formed by the following steps: after electromagnetic radiating, covering the positions where it is not necessary to adsorb abrasive particles, thereby forming an electromagnetic template.

11. A method for uniformly distributing abrasive grits on grinding tools according to claim 9, wherein the template is a plasma-template.

12. A method for uniformly distributing abrasive grits on grinding tools according to claim 9, wherein the template is an electric template with positive or negative charge.

13. A method for uniformly distributing abrasive grits on grinding tools according to claim 9, wherein the sheet is made by mixing metal powder and bond compressed in a mold.

14. A method for uniformly distributing abrasive grits on grinding tools according to claim 9, wherein the sheets of selected layers according to cutting requirements are compressed to be a unity by a static press or a stamping press, then are placed into a mold to be sintered.

15. A method for uniformly distributing abrasive grits on grinding tools according to claim 9 or 14, wherein the cutting tool is formed by multiple sheets, the distribution pattern of abrasive particles on each layer being the same or different.

16. A method for uniformly distributing abrasive grits on grinding tools according to claim 15, wherein the outer layer has a higher density of diamond while the inner layer has a lower density and bigger-size diamond.

17. A method for uniformly distributing abrasive grits on grinding tools according to claim 9, wherein the sheets impregnated with uniform-distributed diamond grit are cut diamond saw segments in a predetermined shape, a plurality of such segments being assembled and placed into a typical graphite mold for making conventional diamond saw segments, after sintering, the segments being consolidated, then the segments being laser welded onto a circular saw according to requirements.

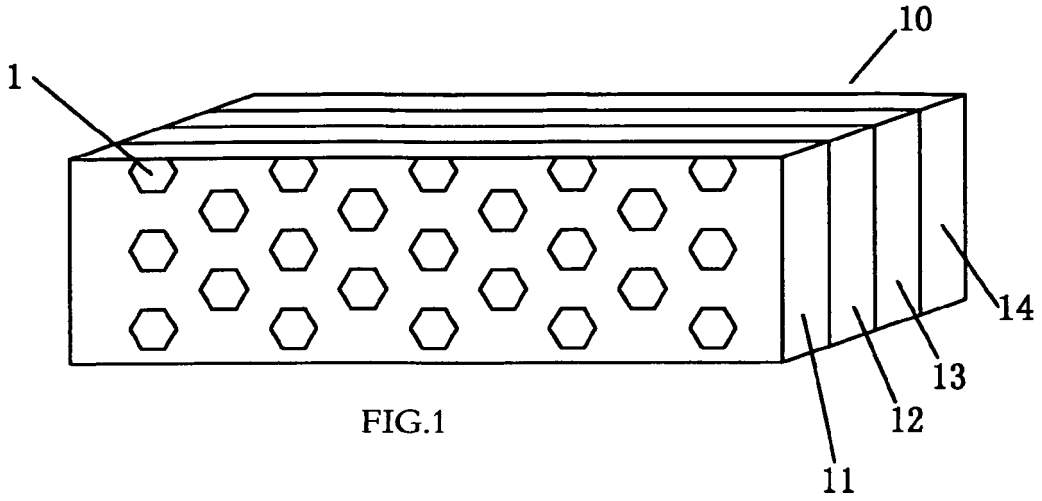

FIG.1

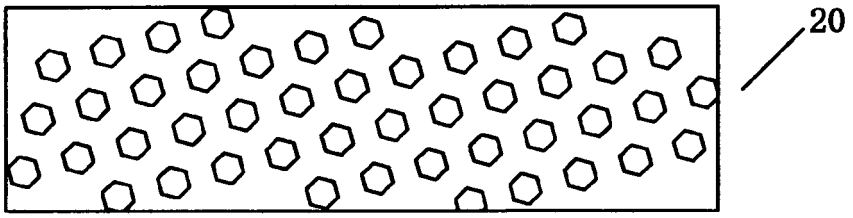

FIG.2A

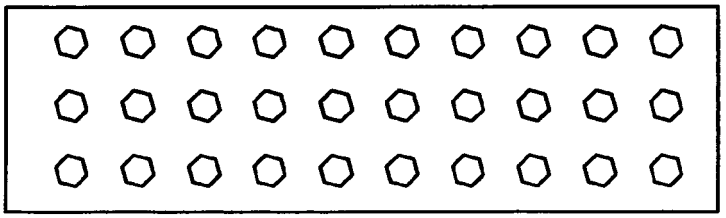

FIG.2B

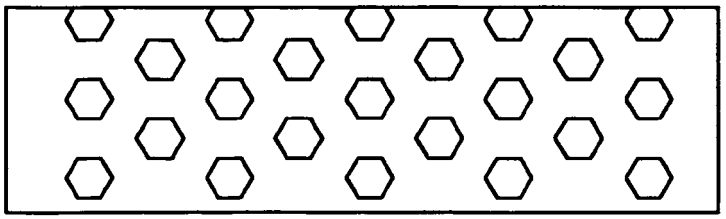

FIG.2C

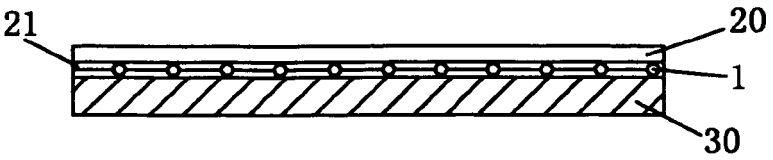

FIG.3

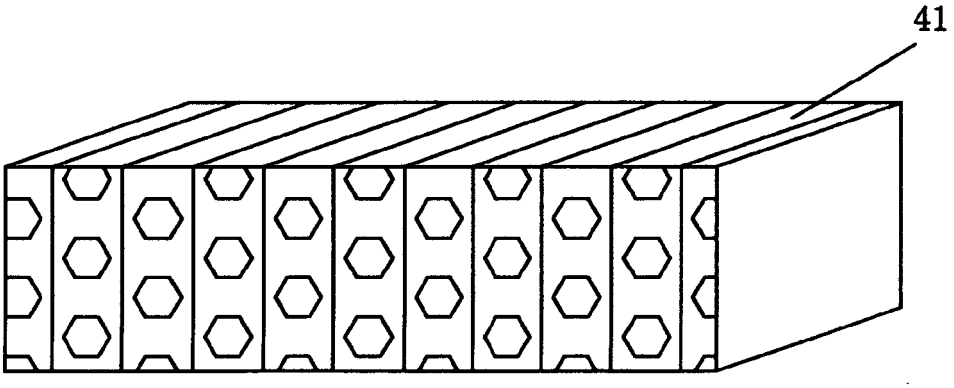

FIG.4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2008/000331

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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)

IPC: B24D11/00,B24D3/00,B24D3/02,B24D3/04,B24D3/06,C30B30/00

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)

EPODOC,WPI,PAJ,CNPAT:

substrate,sheet,layer,back,template,pattern,abrasive,particle,grain,diamond,adsor+,bond,binder,secure,electro+,magneti+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN1252021A(CHIEN-MIN SUNG)3 May. 2000(03.05.2000) see page 6-12, fig. 1A-6C	1-17
Y	JP7136936A(SUMITOMO HEAVY IND LTD)30 May. 1995(30.05.1995) see [0008], fig.1	1-8
Y	JP7207254A(IWATA HIROSHI,SENGOKU YUJI)8 Aug. 1995(08.08.1995)see [0004]	9-17
A	CN1872496A(JIAPIN DIAMONDS IND CO LTD)6 Dec. 2006(06.12.2006)see the whole document	1-17
A	CN1420810A(ULTIMATE ABRASIVE SYSTEMS LLC)28 May. 2003(28.05.2003) see the whole document	1-17

☐ 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

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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

"&"document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 May. 2008(20.05.2008)	**12 Jun. 2008 (12.06.2008)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer SONG, Yiqun Telephone No. (86-10)62085461

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2008/000331

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN1252021A	03.05.2000	WO9845092A1	15.10.1998
		AU6586498A	30.10.1998
		TW394723A	21.06.2000
		EP1015180A1	05.07.2000
		EP19980912057	26.03.1998
		JP2000512219T	19.09.2000
		US6159286A	12.12.2000
		US6286498B1	11.09.2001
		US2002077054A	20.06.2002
		US6679243B2	20.01.2004
		US2003084894A	08.05.2003
		US7124753B2	24.10.2006
		US2004112359A	17.06.2004
		US2004194689A	07.10.2004
		US2005136667A	23.06.2005
		US2006016127A	26.01.2006
		US2007051355A	08.03.2007
		US2007051354A	08.03.2007
		US2007157917A	12.07.2007
		US2007295267A	27.12.2007
		US2008047484A	28.02.2008
		KR20010006017A	15.01.2001
		KR100366466B	31.12.2002
JP7136936A	30.05.1995	JP3051908B2	12.06.2000
JP7207254A	08.08.1995	None	
CN1872496A	06.12.2006	None	
CN1420810A	28.05.2003	WO0143918A2	21.06.2001
		US2001025457A1	04.10.2001
		AU2273001A	25.06.2001
		TW467809A	11.12.2001
		EP1237679A2	11.09.2002
		US6478831B2	12.11.2002
		BRPI0016466A	01.04.2003
		JP2003516871T	20.05.2003
		KR20030028449A	08.04.2003
		CN1188253C	09.02.2005
		KR100537474B	19.12.2005
		EP20000986502	18.12.2000

Form PCT/ISA/210 (patent family annex) (April 2007)

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C30B30/00(2006.01)i

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5024680 A **[0007]**
- US 5062865 A **[0007]**